

# **Course Title: *Wildlife Ecology and Management***

## **Course Code: *Biol2054***

### **UNIT ONE: INTRODUCTION**

#### **1.1. Definition of wildlife**

Before the detail discussion of wildlife let us understand what life is. Life is the condition that distinguishes animals and plants from inorganic matter, including the capacity for growth, functional activity, and continual change earlier to death. Organism is any contiguous living system like animals, plants, microorganisms etc. The term wildlife means different things to different people. To a hunter, it may mean white-tailed deer, bushbuck, and gazelle. To a sheep producer, it may mean coyotes. To a poultry producer, it may mean mink, weasels, skunks, and raccoons. To a gardener, it may mean hummingbirds and butterflies. Early definitions of wildlife focused on wild animals (undomesticated free-ranging animals) that could be hunted for sport or food; therefore, the early definitions restricted the term wildlife to vertebrates (animals with a backbone). From that time forward, the message has been clear: there is a separation of those organisms termed wildlife, not only from other vertebrates, but most certainly from other groups of lower animals and plants.

Wildlife is considered to comprise all the living organisms (plants, animals and microorganisms) in their natural habitat i.e. organisms that are neither domesticated nor cultivated ones living in a natural undomesticated state. Wildlife includes wild animals, usually terrestrial vertebrates whose populations are monitored and managed for exploitation or conservation. Even, there is a definite tendency among certain professionals and amateur groups to consider wild life as the so called “higher forms of life” particularly birds and mammals. This attitude might have given an opportunity for mammals to attract more attention of mankind for their conservation, although mammals predominant in brainpower and survival in varied environments. However, mammals are less diverse than other most animal kingdoms. For example, Insects alone comprises about 800,000 described species, while all vertebrates together numbered not more than 45,000 species.

In the past in the United States wild life was considered to be “all living things that are neither cultivated nor domesticated ones, especially mammals, birds and fishes hunted by man”. Until

about 25 years ago, wildlife was synonymous with “game”, those birds and mammals that were hunted for sport. Accordingly, some countries define “Wild life” in the same sense as game” and therefore exclude fish. Others defined wildlife as all free ranging vertebrates in their naturally associated environments. The management of such species is still an integral part of wildlife management but increasingly it embraces other aspects such as conservation of endangered species.

From the above definitions, there is no precise and universally accepted definition for the term wildlife. Moreover, there are no clear taxonomic or even behavioral boundaries defining wildlife. But, the national and international wildlife federations have similar tendency about the term “wild life”, that include all living things that are living outside the direct control of humans i.e. non-cultivated plants and non-domesticated animals. They do give coverage to plants, invertebrates, fishes, reptiles, amphibians, birds and mammals. However in view of the changing definitions of wildlife, it is not surprising that debate continues about the proper body of knowledge and the principles of wildlife management.

In our country, Ethiopia, the majority of the population coined the term wild life by the Amharic word “ye dur arawit”. It has the meaning of large wild mammals such as, elephants, buffaloes, lions, baboons, bushbucks, nyala, walia, wild pigs and the like, that can be a danger to man and a nuisance/pest to crops. A much more meaningful translation of the term “Wildlife” into Amharic term would be “ye dur hiwot”. Meaning, the spirit of the wild, and the essence of living things that make up wild ecosystems. This term would include all sorts of wild organisms including small mammals, birds, insects, herbs, bushes, trees, lichens, algae, fungi, and in fact all wild living things, where the word “ wild “ means not managed directly by man. Therefore, particularly those of us who work in the field of wild life conservation and management should be in front position to change this miss-conception of the word and work to change people attitude towards proper care for “wilderness”.

## **1.2. The need for wildlife management and conservation**

### **A, What is wildlife management?**

The definitions of wildlife management are as numerous as authors and professional biologists. There are some differences, to be sure, but three common ideas are present in every definition of

wildlife management, including: efforts directed toward wild animal populations, relationship of habitat to those wild animal populations, and manipulations of habitats or populations that are done to meet some specified human goal. You are faced with the difference between value judgments and technical judgments and how these relate to goals and policies compared with options and actions. We take you through the various steps involved in deciding what to do and how it should be done. We describe the decision analysis and matrices and how they help to evaluate feasible management options. “Wildlife” is a word whose meaning expands and contracts with the viewpoint of the user. Sometimes it is used to include all wild animals and plants. More often it is restricted to terrestrial vertebrates. In the discipline of wildlife management it designates free-ranging birds and mammals and that is the way it is used here.

Early wildlife biologists viewed wildlife management as the art of making land produce adequate game for recreational use (hunting, fishing, or trapping). Later definitions emphasized wildlife management as the science of manipulating wild animal populations and their habitats for specific human goals. Current definitions stress wildlife management as applied animal ecology that benefits the habitat and both wildlife and human populations. Until about 25 years ago wildlife was synonymous with “game,” those birds and mammals that were hunted for sport. The management of such species is still an integral part of wildlife management but increasingly it embraces other aspects such as conservation of endangered species. “Wildlife management” may be defined for present purposes as “the management of wildlife populations in the context of the ecosystem.” That may be too restrictive for some who would argue that many of the problems of management deal with people and, therefore, that education, extension, park management, law enforcement, economics, and land evaluation are legitimate aspects of wildlife management, and ought to be included within its definition.

They have a point, but the expansion of the definition to take in all these aspects diverts attention from the core around which management activities are organized: the manipulation or protection of a population to achieve a goal. Obviously people must be informed as to what is being done, they must be educated to an understanding of why it is necessary, their opinions must be investigated and their behavior may have to be regulated with respect to the given goal. However, the most important task is to choose the right goal and to know enough about the animals and their habitat to assure its attainment. Hence wildlife management is restricted here to its literal meaning, thereby emphasizing the core at the expense of the periphery of the field. The

broader extension and outreach aspects of wildlife management are dealt with thoroughly in other texts devoted to those subjects.

### **B, The Need for wildlife management and conservation**

Wildlife has provided and still providing many things to our life. But now a day's man has destroyed the wildlife in the name of modernization. If you are supposed to work in the field of wild life conservation so often you will hear and aware of the question *why care for wildlife?* For example, the majority of people in Ethiopia, through lack of information, think that wild life only has damaging characteristics, particularly where crops are concerned (crop raiding), and that the only reason to conserve it is to do with some vague idea of “heritage”. Species has many values. It contributes the natural “character” of land. Animals contribute to a sense of completeness/wholeness of the land scope. Animals and plant species are of aesthetic, ecological, educational, recreational, scientific, economic, spiritual and strategic values to the nation and its people. Therefore, we have obligation to protect them. So the need for wildlife management and conservation is necessary because it provides the following benefits:-

#### **i) Medicinal**

Humankind used to rely totally on medicines collected from plant and animal materials to cure different diseases for several years before modern pharmaceutical medicines began to be produced. Even in modern pharmaceuticals, around 25% comes directly or indirectly from plant materials. Essential natural chemical compounds in plants also gave clues to produce these chemicals synthetically. For instance, taxol, the only cure for ovarian cancer, which is naturally obtained from Pacific Yew tree, can now be synthesized. Some plants have chemical extracts that can be used as biodegradable pesticides. Three quarters of medicinal plants those are used in pharmaceuticals were discovered through traditional uses.

#### **ii) To maintain essential ecological processes and life support systems**

It is one of the essential roles of wildlife, which is more difficult and vague to be understood and accepted by the majority of people. Essential ecological processes are those processes that are governed, supported or strongly moderated by ecosystems and are essential for food production, health and other aspects of human survival and sustainable development. Such as soil regeneration and protection, the recycling of nutrients, ensuring the availability of quality and clear water, natural regulation of plants and animal population and the many other ecological

processes. The maintenance of such processes and systems is vital for all societies regardless of their stage of development. For instance:

- Majority of higher plants depend for their reproduction on other wild life especially on the transport of pollen by organisms either by wild insects or wild mammals and birds. Changes in Ecosystems by human activities will reduce the efficiency with which reproduction is carried out in many plants.
- Many seeds will not germinate unless they are first passes through the gut of some animals or birds species. This process damages the seed coat and usually transports the seed from one location to another, giving the tree species a chance to occupy new habitat and spread the species further.
- Natural regulation of plant and animal population- Species interact with each other, whether as predators, mutualisms, competitors, herbivore parasites, or pathogens. Thus, a change in abundance of one species is likely to lead to changes in abundance of other species. For example, extermination of top predators leading to extermination of their prey which depend on other prey species. For example, on Panama's Colorado Island, where the elimination of Jaguars, Pumas and Harpy Eagles caused a population explosion of their prey such as monkeys and others, which intern proceeded to exterminate several species of ground nesting birds..
- Natural vegetation cover in water catchments helps in maintaining hydrological cycles, regulating and stabilizing water runoff, and acting as a buffer against extreme events such as flood and drought. Vegetation cover helps to regulate underground water tables, preventing dry land salinity.
- Ecosystems and ecological processes play an important role in the breakdown and absorption of many pollutants created by humans and their activities. These include wastes such as sewage, garbage and oil spills. Components of ecosystems from bacteria to higher life forms are involved in these breakdown assimilative processes.

### **iii) To preserve genetic or biodiversity in general**

Most important contribution of wild life for human progress is availability of large gene pool for the scientists to carry out breeding programs in agriculture, animal husbandry and fishery. It is the range of genetic material found in the world's organisms, on which we depend for the breeding programs necessary for the protection and improvement of cultivated plants and domesticated animals. It is the variety of different genes, as found within a breeding population,

within a whole species or of all species found within a given area. The preservation of genetic diversity is both a matter of insurance and investment necessary to sustain and improve agricultural, forestry and fisheries production to keep open future options, as a buffer against harmful environmental change and as a raw material for much scientific and industrial innovation. It is very essential for the breeding programs in which continued improvements in yields, nutritional quality, flavor, durability, pest and disease resistance, responsiveness to different soils and climates, and other qualities are achieved.

#### **iv) To ensure the human sustainable utilization of species and ecosystem**

This notably includes species of fishes, natural forests and other wild life that support millions of rural communities as well as major industries. The necessity of ensuring the utilization of an ecosystem or species sustainably varies with a society's dependence on the resource in question. For a subsistence society, sustainable utilization of most, if not all, of its living resources is essential. Wildlife can bring two types of economic benefits:

- a. Wild life may be used directly as food, fodder, fuel, fiber etc.
- b. That same wild life may be sold, providing communities or countries with much needed income- commercial benefits. The commercial value of wild life is the capitalized value of the income derived from selling or trading animals/ plants or their products, or from conducting a business based on access to wild life population.

There are two forms of wild life utilization:-

##### **a, Consumptive utilization**

The organism concerned is used up - either killed if an animal, or cut down if a plant. Examples are hunting for meat or skin, harvesting or cutting of wild trees, "sport" hunting, and fishing. In Ethiopia, sustainable utilization and farming of wild life is in its infancy stage; however, there has been encouraging attempts: for instance

- Ostrich farming - at Abijatta - Shalla Lakes National Park
- Crocodile ranching - at Arbaminch, near to Nechisar National Park.
- "Sport" hunting, at different controlled hunting areas
- Trophy sales ( ivory, skins of spotted cats & colobus monkey)
- Live animal export (reptiles, monkeys, baboons, birds and others).

##### **b, Non - Consumptive utilization**

The organism is available again and again to generate income, or its products are harvested without killing it. In Ethiopia, there are examples with regard to this form of utilization such as the following:

- ✓ Tourism industry - tourist viewing of wildlife and scenery
- ✓ Civet must collection- from individually reared animals
- ✓ Wild coffee collection- from natural forest
- ✓ Incense and gums collection- from arid and semi-arid parts of Ethiopia.

#### **v) Recreational and aesthetic value**

**Recreational value:** - people derive benefits of pleasure, adventure, and enhanced physical and mental health from outdoor activities involving the pursuit or sometimes-accidental enjoyment of wild life. People can recreate by hunting, fishing, bird watching, photographing, hiking, and camping and by other wildlife based outdoor activities. Sometimes these activities are take place in conservation areas such as National parks, sanctuaries, game reserves which are set aside for the purpose, or sometimes they take place in remote or unpopulated areas where there is little other possible use for the land. Ethiopia is endowed with many places, conservation areas (parks, controlled hunting areas, sanctuaries and game reserves), natural forests and mountains which have recreational values and benefits.

**Aesthetic value:** - it is the most personal and variously conceived value of wild life. Many people get pleasure from visiting natural ecosystem and wild animals. Some wild animals have special charisma, are beautiful and spectacular, and therefore, are sources of pleasure for many people. Wild animals and plants attract not only biologists, but also several naturalists, explorers, painters, photographers, writers, poets and musicians. They have shaped the human culture in some way. Everyone appreciates the sight of a lion, leopard, colorful birds, beautiful mountain scenery, songs of ducks etc. This is beautiful that meets the eye and ear, and our response to it seems innate. Aesthetic values of wild life are usually impossible to quantify. They are values that stir the emotions and they are often the first value that attracts and initiates people to the conservation of wildlife.

#### **vi) Educational and scientific values.**

The scientific value of wild life is the value of wild populations as object of scientific study. Wild life and their habitats can be considered as field laboratories where scientists such as ecologists, evolutionists, geneticists, behavioral researchers and others can do study to extend

their knowledge in their discipline. The modern science of gene technology, which allows researchers to use and manipulate the gene characteristics of different species of animal and plants, continued discovery of new and useful genes that can be transferred from one species to another (in order to improve viability, disease resistance, survival and/or other qualities)- are scientific values of wild life.

#### **vii) Cultural values of wild life**

Many types of wildlife and their products have great significance in local cultures/ceremonies or beliefs. Certain trees and plants are collected for their special beliefs (healing properties) or for their ability to ward off evil spirits and events. Amongst certain societies/local communities, feathers (from ostrich or other different colorful birds), skins from certain animals (e.g. leopard), horns from greater kudu or other animals are used or displayed at different ritual ceremonies.

### **1.3. Scope of wildlife management**

The scope of wildlife management cannot be put under small scope because of its broadness in nature. But generally it includes the application of scientific and technical principles to wildlife populations and habitats to maintain such populations for recreational and/or scientific purposes (i.e. the maintenance of a wild population for the continued existence of the species). Wildlife management includes parks and reserves, altering and rehabilitating wildlife habitats, pest control, protecting human life and property, and managing harvests of wildlife. In this regard, there are different approaches that are used in the wildlife management. Wildlife management by definition attempts to balance the needs of wildlife with the needs of people using the best available science. Wildlife management can include game keeping, wildlife conservation, human and wildlife conflict, and pest control. It has become an integrated science using disciplines such as mathematics, chemistry, ecology, climatology, biology and geography to gain the best results.

Wildlife management includes the following:

- ☞ **Conservation:** Conservation is nothing but the natural systems are actively managed by man to maintain and use natural resources in such a way as to preserve its biodiversity for future generations of man and animal. Conservation is an effort to maintain and use natural resources wisely in an attempt to ensure that those resources will be available for future generations. Wise use of resources could vary from actively managing white-tailed deer populations by hunting to protecting and preserving spotted owl populations and



habitat. It includes the preservation, maintenance, sustainable utilization, restoration and enhancement of the environment. Examples are State Forests and Recreation Areas.

- ☞ **Preservation:** - is a subset of conservation and refers to protecting a resource by withdrawing it from use or preservation is natural systems that are left alone without human disturbance or manipulation. Active management may be required to maintain or recreate naturally occurring populations of animals and plants. Basically, areas are protected from destruction and are left so that nature takes its course. When nature takes its course, it may not always be favourable for the wildlife involved as change is inevitable in natural systems. Examples are National Parks and Reserves areas and Sanctuaries. Some habitats, for example, may become endangered; the remaining habitat is often protected from use.
- ☞ **Restoration:** - Restoration is also a subset of conservation, and refers to returning a resource to some prior condition. Usually restoration is emphasis to reestablish ecological processes and functions. For example, riparian areas in many parts of the arid western U.S. have been degraded by excessive grazing to the point that they no longer function effectively as fish and wildlife habitats. Conservation efforts in these areas often seek to reestablish native vegetation and restore natural water cycles.
- ☞ **Management:** - is also subset of conservation, it refers to controlling, directing, or manipulating wildlife populations and/or their habitats. This manipulation may be in order to increase the size of the population for species security; to “harvest” animals in a sustainable way; or to reduce/stabilise a population. Management can be applied to both pest and desirable species. Examples are Fisheries and Aquaculture, hunting wild animals. Management may be used within areas of preservation and conservation in order to achieve the goals of each.

### 1.3.1. Kinds of wildlife management

Wildlife management implies stewardship that is the looking after of a population. A population is a group of coexisting individuals of the same species. When stewardship fails, conservation becomes very important. Under these circumstances, wildlife management shifts to remedial or

restoration activities. There are two general types of wildlife management based on their objectives:-

**i. Active or Manipulative management**

- Does something to a population, either by changing its numbers directly or influencing numbers by the indirect means such as, altering food supply, habitat, density of predators, or prevalence of disease.
- Is appropriate when a population is to be harvested, or when it slides to an unacceptably low density, or when it increases to an unacceptably high level.

**ii. Passive or custodial management**

- Custodial management on the other hand is preventative or protective.
- It is aimed at minimizing external influences on the population and its habitat.
- It is not aimed necessarily at stabilizing the system but at allowing free rein to the ecological processes that determine the dynamics of the system.
- Such management may be appropriate in a national park where one of the stated goals is to protect ecological processes and it may be appropriate for conservation of a threatened species where the threat is of external origin rather than being intrinsic to the system.

Active management of wildlife is vital because of the following reasons:-

- To ensure species survival
- Humankind has already injured nature to a great extent- unlimited exploitation ultimately lead to extinction of species.
- There is almost nothing in nature that can be called a “stable environment “even within the large blocks of undisturbed climax rain forests. The element that managers wish to preserve or protect in conservation area can easily be lost through lack of management simply because the nature of the reserve changes.
- Any conservation area naturally continues to change as wind, animals, man or other agencies introduce new species. Other species drop out through local extinction, disease, pest, succession and other ecological factors.

Consequently, it is clear that, a good deal of active management is needed to maintain the qualities managers wish to preserve in conservation area. However, it must also be stressed that interference with natural processes is full of dangers unless cautiously manipulated. Therefore, it requires proper understanding of ecological principles and an appreciation of the ecological

processes operating in nature before manipulation natural system/ wild life resources. Regardless of whether manipulative or custodial management is called for, it is vital that the management problem should be identified correctly, the goals of management explicitly should address the solution to the problem and criteria for assessing the success of the management should be clearly identified.

### **1.3.2. Goals of wildlife management**

There are many different reasons why we might want to manage wildlife; and the relative importance of those reasons can vary from place to place; both within a country and around the world. This importance can also change from time to time. Managing a particular species may be critical in one country, where for various reasons it has become a pest; while the same species may in a different country be controlled by nature with very little need for intervention by humans.

Wildlife management was developed as a discipline in the early 1930s; the goal was to provide wildlife resources for sport hunting. Aldo Leopold, who is regarded as the father of wildlife management, defined wildlife management as the art of making land produce sustained annual crops of wild game for recreational use. With the exception of predator control, support of sport hunting remained the principal and often the sole goal of wildlife management for nearly 40 years. However, by the 1960s, because of, or as part of, a growing environmental awareness and concern among the public, the attention of the wildlife management profession began slowly to broaden its focus to include non-game wildlife and non-consumptive uses of wildlife. Gradually the goals were broadened.

Today, in addition to providing sport hunting, the goals involve managing wildlife in support of a number of human interests and concerns, including:

- Maintenance of the ecosystems of which they are a component and the ecological services that they and their ecosystems provide.
- Protection and restoration of populations of endangered species.
- Maintenance of healthy wildlife populations in national parks and reserves and
- Encouragement of suitable wildlife species in urban situations.

- In some countries other than the United States, the provision of a sustainable yield of wildlife for commercial and subsistence purposes is another current goal of wildlife management.

A wildlife population may be managed in one of the following four ways/goals:

- i. *Make it increase*; this option usually applies to small, depleted, or decreasing populations.
- ii. *Make it decrease*; this usually applies to populations that are judged to be too high or increasing too rapidly. That is, if the population number is beyond the carrying capacity.
- iii. *Harvest it for a continued yield on sustainable bases*- which requires leaving enough or viable numbering of individual in the population so that to insure their reproduction to replace those removed or harvested.
- iv. *Leave it alone* but keep an eye on it/keep on watching the changes i.e. monitor it but do not seek to manipulate it.

These are the only options available to the manager. The first three options imply manipulative management, which involves changing the population level of the species involved, either through direct methods, such as hunting, or indirectly by changing the habitat, for example, through provision of water or reduction of predators or disease. The fourth option represents custodial management: for example, in the management of a national park or reserve where the objective is to “let nature take its course.” In wildlife management we need three important decisions. These are:

- a. What is the desired goal? This is the responsibility of the political system or other decision makers, not that of the wildlife manager.
- b. Which management option is therefore appropriate to achieve the goal? and
- c. How to implement that management approach or by what action is the management option best achieved?

These decisions are fall on either of two types of judgments; the first decision requires a judgment of value and the others require technical judgments. Since value judgments and technical judgments get confused it is important to distinguish between them.

- A. A value judgment is neither right nor wrong because different people have different value.

- B. A technical judgment can be classified as right or wrong according to whether they succeed in achieving the stated goal. The wisdom of a technical judgment can be evaluated according to strict criteria.

Wildlife manager to make the necessary value judgments in determining the goal any more than it is within the competence of a “general” to declare war. Managers may have strong personal feelings as to what they would like, but so might many others in the community at large. Managers are not necessarily provided with heightened aesthetic judgment just because they work on wildlife. They should have no more influence on the decision than does any other interested person. However, when it comes to deciding which management options are feasible (once the goal is set), and how goals can best be attained, wildlife managers have the advantage of their professional knowledge. Now they are dealing with testable facts. They should know whether current knowledge is sufficient to allow an immediate technical decision or whether research is needed first. They can advise that a stated goal is unattainable, or that it will cost too much, or that it will cause unintended side effects. They can consider alternative routes to a goal and advice on the time, money, and effort each would require. These are all technical judgments, not value judgments. It is the task of the wildlife manager to make them and then to carry them through. Since value judgments and technical judgments tend to get confused with each other it is important to distinguish between them.

By its essence a value judgment is neither right nor wrong. Let us take a hypothetical example. The black rat (*Rattus rattus*) is generally unloved. It destroys stored food, it is implicated in the spread of bubonic plague and several other diseases, it contributes to the demise of endangered species, and it has been known to bite babies. Suppose a potent poison specific to this species were discovered, thereby opening up the option of removing this species from the face of the earth. Many would argue for doing just that, and swiftly. Others would argue that there are strong ethical objections to exterminating a species, however repugnant or inconvenient that species might be. Most of us would have a strong opinion one way or the other but there is no way of characterizing either competing opinion as right or wrong. That dichotomy is meaningless. A value judgment can be characterized as hardheaded or sentimental (these are also value judgments), or it may be demonstrated as inconsistent with other values a person holds, but it cannot be declared right or wrong. In contrast, technical judgments can be classified as right or wrong according to whether they succeed in achieving the stated goal.

To sum up, reasons for managing wildlife may (amongst other things) include:

- ☞ The population of an animal may be increasing too much and is impacting (or may impact) on other species (plant and animal).
- ☞ Unintentional introduction of a non indigenous or native species to an area may have changed the balance of nature.
- ☞ Climate change, abnormal events (eg. Natural disaster) or development activity, may have changed or caused instability in the balance of nature.
- ☞ Control of disease carried by animals (Diseases that affect domestic animals, livestock, other wildlife and even humans).
- ☞ Conserving threatened species.
- ☞ Studying different species.
- ☞ Sustaining a harvestable resource (eg. Fish populations in the oceans).
- ☞ Protecting individual animals from unnecessary or unethical harm.

## **UNIT 2: ECOLOGICAL REQUIREMENTS OF WILD ANIMALS**

### **2.1. Food and nutritional requirements wild animals**

Obviously, wildlife must have food to survive. Animals having adequate food and proper nutrition throughout their lives grow larger and remain healthier than animals that experience poor nutrition during part or all of their lives. Generally, wildlife in good condition has higher reproduction rates, is more resistant to diseases, and can escape predators better than animals in poor condition. Nutrition affects birth and death rates and is important in the overall survival of any wild animal population. The availability of food varies over time (season) and space (geographic location). Food can be abundant in one area during one season and in critically short supply in another area during other seasons. Cold weather forces animals to consume more food to maintain body heat.

If food supplies are the focus of a wildlife management plan, landowners should be sure to provide high quality food during late summer and late winter/early spring. Diet selection in wildlife is driven by the quantity and quality of available food in concert with the nutritional needs of the animal. For instance, coyotes are carnivores adapted for eating a diet of small animals (mice, voles, etc.) during much of the year. However, when insects, fruits, and berries

are abundant in summer, as much as 80% of a coyote's diet will consist of these food items. Likewise, wild turkey, bobwhite quail, and ruffed grouse are seed or grain eaters (granivores) much of the year, but they consume large amounts of insects (insectivores) during the reproductive season to meet their high protein requirements during this season.

Food availability for a predator animal means prey availability. Predators generally do not experience problems with diet quality because most animal matter is nutritionally complete and easy to digest. Even though carnivores expend a large amount of energy in searching for, chasing, capturing, and killing their food/prey, this extra expenditure of energy is offset by the higher nutrient concentration found in animal matter. Herbivores or plant eaters may become nutritionally stressed by a lack or shortage of food (quantity) or by a lack of highly nutritious food (quality). For example, in years when acorns are abundant, white-tailed deer are healthier because much of their diet consists of high energy acorns. During years when acorn crops are not very good, deer still have plenty of food to eat (tree twigs, grass, etc.), but they may become nutritionally stressed because these plants do not contain as much energy as acorns. Herbivores do not feed randomly in the environment, but show definite feeding patterns. These patterns are called *food preferences* (ranking a food according to how much is found in the diet in relationship to how much is found in the environment). This ratio of utilization over availability is a good indication of wildlife food preferences.

In wildlife management, there are three main aspects that require knowledge of the food and nutrition of animal populations; and are given below.

- a. To support and conserve the rare or endangered species is there enough food available?
- b. To support a particular sustained yield what is the food supply needed?
- c. To provide more effective control of pest populations can we alter the food supply

From the point of view of wildlife management, however, we are interested in two main types of information to answer the above aspects: we need to know the availability of the food and the requirements of the animals. The availability of food varies over time (season) and space (geographic location). Food can be abundant in one area during one season and in critically short supply during other seasons.

### **Constituents of food**

**Energy:** Energy is a power which may be translated into motion, overcoming resistance, or effecting physical change; the ability to do work. Energy is measured in units of calories or joules (1 cal = 4.184 J). Differences in the energy content of different plant and animal materials are due to the differences in their constituents. The energy content of some of the common components of food is as follows. The gross energy of tissues depends on the combination of these basic constituents, particularly in animals. In plant tissues, energy content remains relatively uniform and in the region of 4.0–4.2 kcal/g. Plant parts with a high oil content such as seeds (over 5 kcal/g), or evergreen plants with waxes and resins such as conifers and alpine plants (4.7 kcal/g), are the exceptions.

**Proteins:** Chemically, Proteins are polymers of molecular units called “*amino acids*”. For this reason, the amino acids are referred as “building blocks of proteins”. Generally, all amino acids contain carbon, hydrogen, oxygen and nitrogen atoms. Proteins are major components in cell walls, enzymes, hormones, and lipoproteins. Most animal species have a relatively similar gross composition of amino acids. For carnivores, the nutrient composition of their prey is usually well balanced to a consumer’s specific needs, whereas in herbivores the foods eaten may be deficient in key nutrients. Most prokaryotic (Bacteria) and eukaryotic (Plant) cells are capable of synthesizing all the amino acids present in the proteins. Higher animals like mammals, possess this ability for certain amino acids but not for all. Man can synthesize ten amino acids out of twenty from metabolic intermediates, which are called as “Non-essential Amino acids”. The other ten amino acids that are needed for normal functioning of the animal are called “Essential Amino acids”. These must be obtained from the diet. The deficiency of any one prevents the growth in animals and may even cause death.

**Minerals:** Minerals make up only 5% of body composition but are essential to body function. Some minerals (roughly in order of abundance: calcium, phosphorus, potassium, sodium, magnesium, chlorine, sulfur) are present or required in relatively large amounts (mg/g) and are called *macroelements*. Those that are required in small amounts (µg/g) are called trace elements (iron, zinc, manganese, copper, molybdenum, iodine, selenium, cobalt, fluoride, chromium). So far very little is known about the mineral requirements for wildlife species. However, some mineral deficiencies have been observed. Selenium deficiency increases the mortality of



juvenile, preweaned (wean means accustom (an infant or other young mammal) to food other than its mother's milk.) mammals.

**Calcium** and **phosphorus** are essential for bones and eggshells. Cervids (A mammal of the deer family) have a very high demand for these minerals during antler (*Antlers* are the usually large, branching bony appendages on the heads of males of most deer species.) growth. Calcium is also needed during lactation, for blood clotting, and for muscle contraction. Phosphorus is present in most organic compounds. Deficiencies of calcium result in osteoporosis, rickets, haemorrhaging, thin eggshells, and reduced feather growth. Carnivores that normally eat flesh of large mammals need to chew bone to obtain their calcium. Chicks of Cape vultures in South Africa developed rickets when they were unable to eat small bone fragments. This has an important management consequence: bone fragments from large carcasses are made available to vultures by large carnivores, in this case lions and hyenas. This is a good example of how the interaction of species should be considered in the management and conservation of habitats.

**Sodium** is required for the regulation of body fluids, muscle contraction, and nerve impulse transmission. Sodium is usually in low concentrations in plants, so herbivores face a potential sodium deficiency. In areas of low sodium availability, herbivores consume soil or water from mineral licks. Carnivores can easily obtain sodium from their food, and so are unlikely to experience sodium deficiency. Both potassium and magnesium are abundant in plants, and deficiencies in free-living wildlife are therefore unlikely. Trace element deficiencies are unusual under normal free-ranging conditions, but they occur locally from low concentrations in the soil.

**Vitamins:** Vitamins are essential organic compounds which occur in food in minute amounts and cannot normally be synthesized by animals. There are two types of vitamins, fat soluble (vitamins A, D, E, K) and water soluble (vitamin B complex, C, and several others). Fat-soluble vitamins can be stored in the body. Water-soluble vitamins cannot be stored and hence must be constantly available. Overdose toxicities can arise only from the fat-soluble vitamins. Vitamin A, a major constituent of visual pigments, can be obtained from  $\beta$ -carotene in plants. Vitamin D is needed for calcium transport and the prevention of rickets. Vitamin E is an antioxidant needed in many metabolic pathways. It is high in green plants and seeds, but decreases as the plants mature. Vitamin K is needed to make proteins for blood clotting. Deficiencies are unlikely to occur because it is common in all foods. The vitamin K antagonist, warfarin, causes

hemorrhaging. It is used as a rodenticide. Little is known about the B-complex vitamins and whether deficiencies occur in free-living wildlife species, although cases of thiamin (B1) deficiency have been reported for captive animals. Vitamin C differs from the others in that most species can synthesize it in either the kidneys or the liver. Exceptions include primates, bats, guinea pigs, and possibly whales. Vitamin C is not as commonly available as the B vitamins but is found in green plants and fruit.

### **Variations in food supply**

**Seasonality:** Food supply varies with season. To some degree all environments are seasonal, including those of the tropics. Food supply is greatest for herbivores when plants are growing, during the summer at higher latitudes (temperate and polar regions) and during the rainy season in lower latitudes (tropics and subtropics). Protein in grass and leaves declines from high levels of 15–20% in young growth to as little as 3% in mature flowering grass, or even 2% in dry, senescent grass. Leaves from mature dicots maintain a higher protein content of about 10%. Thus herbivores such as elk in North America and eland and elephant in Africa will switch from grazing (is eating grass) in the growing season to browsing (is eating woody twigs) in the non-growing season. Many forest-dwelling Australian marsupials are mycophagous, that is they prefer to feed on the sporocarps of hypogeous (Underground) fungi. They feed on dicot fruits and leaves when fungi are not about.

Some animals adjust their breeding patterns so that their highest physiological demands for energy and protein occur during the growing season. Thus northern **ungulates** ("*ungulate*" refers to any animal with hooves) give birth in spring so that lactation can occur during the growing period whereas tropical ungulates produce their young during or following the rains, allowing the mother to build up fat supplies to support lactation. Although most birds complete their entire breeding cycle during one season, the timing of breeding is closely associated with food supply.

**Year to year variations in food supply:** A particular kind of variability in food supply occurs with the production of prolific seed crops by some tree species. This seed is termed **mast**. It occurs when the majority of trees in a region synchronize their seed production. Beech trees (*Fagus*, *Nothofagus*) and many northern hemisphere conifers (e.g. white spruce, *Picea glauca*) produce their seeds at the same time, these mast years occurring every 5–10 years. Birds like crossbill (*Loxia curvirostra*) that depend on these conifer seeds breed throughout the winter

when a mast cone crop occurs. In the following year, when few cones are produced, the crossbills disperse to find regions with a new mast crop, sometimes travelling many hundreds of kilometers.

### **Wildlife studies of food habits and preferences**

Different methods have been used to study food preferences of wild animals. Each method has its own limitations, being applicable to some, but not all, species or season of the year and involving possibilities for biased results. The methods include:

- a. Feeding site observations
- b. Observation of the digestive tract
- c. Observation of feces
- d. Observation of regurgitated pellets
- e. Observation of food remains and signs
- f. Observation of preference trails

### **Strategies of digestion**

**Carnivores** and **omnivores** digest their food in the stomach and small intestine. The small intestine is relatively short in these species. **Herbivores**, which make up most (about 90%) of the mammals, need to digest large amounts of fairly indigestible cellulose and hemicelluloses, and to do so they have adapted the gut to increase retention time. One strategy is to evolve a much longer small intestine. An exception is the giant panda which evolved from bears and has retained the short intestine.

**Ruminants:** True ruminants, which include the bovids (cattle, sheep, and antelopes), cervids (deer), tylopodids (camels), and giraffes, have an extension of the stomach divided into three chambers. One of these is the rumen, which acts as the fermentation chamber. Plant food is gathered without chewing and stored in the chamber during a feeding period. This is followed by a rumination period during which portions of compacted food (bolus) are returned to the mouth for intensive chewing. In this way coarse plant material is broken down mechanically and made available to the microorganisms for fermentation. The amount of fiber in the food determines how coarse it is, and the coarser the food the longer the process of grinding and fermentation. There is a limit to how coarse the food can be before fermentation takes so long that the animal

uses more energy than it gains. On average a ruminant retains food in the gut for about 100 hours.

**Hind gut fermenters:** In contrast to the foregut fermenters, or ruminants, a number of animal groups have developed an enlarged colon or cecum or both to allow fermentation. Large animals (> 50 kg) are in general colon fermenters, while small ones (< 5 kg) which feed on fibrous food are cecum fermenters. Animals in this group are horses, rhinos, kangaroos, and perhaps elephants. These are all large animals and so do not need to ingest high energy and protein per unit of body weight. Since food material can be retained in the gut for longer periods in large animals, the rate of passage may be slow enough for fermentation and absorption of fatty acids to take place. None of these animals eat their feces. The animals that eat their feces and such practice are called as coprophagy.

Small animals (< 5 kg) have a relatively high metabolic rate. Those species which feed on high fiber diets such as grass and leaves need to use the microbial protein produced by hindgut fermentation. They do this by coprophagy. In conjunction with this process there is a sorting mechanism in the colon that separates fluids, small particles of food, and microbes from the fiber. The fluids and microbes are returned by antiperistaltic movements to an enlarged cecum for further fermentation and digestion. This mechanism, therefore, retains the nutrients long enough for fermentation. It is necessary because small animals cannot hold food material long enough for fermentation under normal passage rates. After understanding the food and nutritional requirements, let us understand the feeding adaptation in animals.

The wild animals can be classified broadly into different categories based on their feeding adaptations. They are herbivores, carnivores, omnivores and scavengers

### **2.1.1. Herbivores**

Herbivores are the animals that get their energy by eating only plants materials. Herbivores are *primary consumers* in the food web usually eat the plant that absorb and store energy from the sun through photosynthesis. *Herbivore* is a descriptive term encompassing many types of animals, although it is used mostly for the ungulates—large, hoofed mammals, such as elephants, sheep, and horses, it also includes rabbits, squirrel, etc. The digestive systems of herbivorous mammals are similar because they all need to digest the cellulose in tough plant material. However, herbivores display many adaptations for ingestion and digestion of food. Among these

are the high-crowned, hard-wearing, flat, grinding molars of ungulates. Rodents, such as beavers, have large, continuously growing, chisel-shaped incisors to gnaw plant bark. Snails use a radula, a small, spiky, rasping organ to tear off tiny fragments of leaf.

The ruminants, for example, cows and sheep, possess a four-chambered stomach housing microorganisms that break down the cellulose into a more digestible form, obtaining food and shelter in the stomach in return. Most herbivores eat a variety of plants, but some are restricted to one type of food and are known as *monophagous* herbivores. The koala, for example, exists solely on eucalyptus. Generally, herbivores may be classified as nectivorous (nectar eating), frugivorous (fruit), granivorous (seed), folivores (leaves), graminivores (grass eating), grazers and browsers.

Because of their marked food preference herbivores have the following food type:

- ☞ *Preferred foods*: usually high quality food
- ☞ *Emergency food*: less preferred and usually of mediocre/adequate quality; it becomes especially important when all preferred foods have been used. It may sustain a herbivore population through a critical period of food shortage
- ☞ *Starvation foods*: food item of inadequate quality and eaten only when other foods are absent. Use of starvation foods indicates that the habitat is inadequate and cannot support the herbivores that present in the area

### **2.1.2. Carnivores**

Carnivore is a general term for any animal that survive mainly on the flesh of other animals. More specifically, it refers to any member of the mammalian order Carnivora. The carnivores are at the top of the food chains that make up the food web of the earth's life forms. They feed on herbivores.

The jaws of the Carnivora are powerful and move only up and down on a transverse hinge with none of the rotary motion found in other animals. The teeth have been adapted for the feeding habits, so that in most carnivores each jaw contains six pointed cutting teeth; two strong, sharp, re-curved canines; and molar teeth that have been developed into cutting blades. The number of molars varies among the different families. The cats have only a single vestige of molar in each jaw, whereas dogs retain more molars, which they use for bone crushing. The bears, except for

the polar bear, are omnivorous, and their back molars show tubercles on the crowns, which improve their ability to grind vegetable matter. The digestive system of carnivores is much less complicated than that of herbivores because it does not have to break down the cellulose in plant matter.

### **2.1.3. Omnivores**

Omnivore is an animal that eats both animal flesh and vegetable matter. The term *omnivore* indicates similarities in the behavior and physiology of many unrelated animals; for example, many small birds and mammals are omnivorous. Because of their wide food preferences, omnivores are usually less specialized in their food gathering habits than either carnivores or herbivores. Depending on food supply, the Spotted Skunk feeds mainly on mice and rats during the winter season and on seeds and insects in the summer months. Similarly the Mockingbird varies its diet between berries and insects, depending on the time of year. Many animals that are described as being carnivorous are actually omnivorous; the Grizzly bear supplements its diet of flesh with grasses, herbs, nuts, and berries, and the Red fox feeds on fruits and berries as well as animal flesh. Omnivores can be both primary and secondary consumers within the food web. The digestive systems of omnivores are adapted to greater variety within the diet. The teeth of omnivorous mammals possess special features common to the teeth of both herbivores and carnivores.

### **2.1.4. Scavengers**

A scavenger is a consumer that eats the tissue of dead organisms. Scavenging is both a carnivorous and herbivorous feeding behavior in which individual scavengers search out dead animal (corpses or carrion) and dead plant biomass on which to feed. Scavengers play an important role in the ecosystem by contributing to the decomposition of dead animal and plant material. Decomposers and detritivores complete this process, by consuming the remains left by scavengers.

## **2.2. Wildlife Water Requirements**

Water can be a critical factor in determining the abundance and distribution of wildlife, especially in arid ecosystems, although the impact varies by species, habitat and season. Over the past 150 years, the availability and distribution of water have been drastically altered by both natural processes and human actions. Among key factors: agricultural irrigation and municipal

water use that have lowered water tables; diversions to enhance recreational facilities; historical overgrazing by domestic livestock; damming for irrigation and flood control; and the spread of urban and suburban development. Other factors, such as the disappearance of vegetation cover and changing climatic patterns, exacerbate the problem.

Water is a necessary dietary component, participating in many chemical and physical processes in wild animal's life. Animals require water for several reasons: digestion and metabolism, reducing body temperature, and removal of metabolic wastes. Most wildlife can survive for weeks without food but only days without water. Wildlife can also obtain water through a diet of green plants, from dew on leaves, or as a byproduct of the body breaking down fat and starches. Water requirements of animals vary, and sometimes the importance of free-standing water is over-estimated. However, the availability of properly distributed standing water usually enhances a wildlife population. Growth, size, reproduction, and general body condition usually benefit from optimum water supplies. When a wildlife species does require drinking water, its habitat must include a permanent water source, or the animal must move to areas with water during dry weather. As a final note, lack of rainfall indirectly affects wildlife by reducing the quantity and quality of available wildlife food plants.

Wildlife obtains water from four sources:

- a) *Free water*- From external sources such as streams, lakes, rivers and ponds
- b) *Preformed water*- Found in the food such as succulent vegetation
- c) *Metabolic water* -Produced in the body from the oxidation of organic compounds
- d) Utilization of *dew/water droplets* on cool outdoor surface

Water requirements of wild animals will vary with weather conditions and according to seasonal pattern of physiological functions. Water intake must increase in hot weather to replace that lost by evaporative cooling. The demand of reproduction can also increase the water requirements of wild animals. Water requirement is also vary greatly among species, since some animal species are adapted to arid environments, some to cooler environments etc. Let us study the different adaptations of wild animals to arid environments:-

- ☞ **Nocturnal or fossorial habits:** Many desert adapted species avoid the demands of evaporative cooling by confining most of their activities to times and places with lower temperature and high humidity. Many rodents and insects simply avoid the desert heat by going underground during the heat of the day and by being active at night.

- ☞ **Concentrating excreta:** Desert adapted species produce dry feces and have specialized kidneys that concentrate urine, reducing water loss for these functions. In such a way they conserve water.
- ☞ **Morphological adaptations:** Usually large body size and abundant insulation can prevent heat uptake and provide mass for 'thermal inertia'. In big mammals, insulation is usually greatest on the back to protect skin from the sun. Other body parts may be scantily haired to enhance heat loss by convection. These body parts may be enlarged, like elephant ears, to expel heat; or they may be associated with mobile appendages or hair patterns that increase air movement, enhancing heat loss by convection.
- ☞ **Use of metabolic water:** Oxidation of carbohydrates and fats produces water in the body to augment intake. Such water used internally.
- ☞ **Water storage-**Some species are physiologically adapted to withstand temporary reductions in body fluid levels. Ruminants have an advantage in that water can be stored in the rumen. Desert big horn sheep can withstand losing 30 % of their body water, mostly from the rumen, and can re-hydrate quickly by refilling the rumen.
- ☞ **Mobility:** Birds have the advantage of flight in visiting water sources distant from their feeding, roosting, or nesting sites.
- ☞ **Patterns of reproduction-** The reproductive seasons of most desert wildlife are timed to avoid the driest period of the year. This usually enhances reproductive success in that both water availability and forage quality are best at a critical time.

In general, water availability may vary greatly among years, seasons and geographic locations. Particularly, humans greatly influence the availability of water. Historically, humans have been concentrated in areas where there is adequate availability of water sources. Springs have been diverted or developed for livestock or human use. Roads have followed streams and housing has been built along rivers. These developments have deprived access to water of wildlife. However, there are some efforts by humans to manage water sources of wildlife.

### 2.3. Wildlife shelter Requirement

Cover/shelter is any part of an animal's environment that provides protection and enhances the survival or reproduction of the animal. Often landowners, and almost everybody else, think of cover as something animals hide under. Actually wildlife cover has three components to provide:

- Shelter from adverse weather conditions (winter or thermal cover),



- Breeding site, and
- Protection from predators (screening or escape cover).

Cover is used in several senses that may lead into confusion. In one usage, it is shelter from weather, a place to get in out of the sun and wind, or conversely a place to lie or stand in the sun or wind and even to hide from disturbances/enemies. Cover may be provided by the arrangement of the vegetation or by the ground itself- an animal may seek shelter on a cliff face or a deep valley. Wild animals have evolved their requirements for cover by gaining anatomical, physiological and behavioural adaptations that permit them to use structural resources of the environments in a way that enhance reproduction and/or survival.

In addition to provide shelter, cover may favor the welfare of the animals by providing any natural function such as:

- Avoid or escape potential predators,
- Locate a mate,
- Obtain sufficient food and water for survival,
- Breeding, rearing young, nesting or resting
- Move about or travel

### **Cover requirements**

Hunting affects cover requirements. Animals that at other times are found in open ground may seek deep shelter during hunting seasons. But those species that depend on sight and speed to locate and escape from enemies may seek the most open area. Hunting has been a factor in the decline of many desert and plain animals. Cover requirements of wild animals vary among species although some overlap occurs. Occasionally, various species of birds, mammals and even reptiles have been found using the same nesting cover in holes, on trees or in the ground. However, variation among species is more common. In a given species, the needs for cover will vary with the following factors:

- ↳ Activity of the animal
- ↳ With season and weather conditions
- ↳ Among age and sex classes
- ↳ According to prevalence of predator or pests
- ↳ Among geographic regions

#### ↳ Site disturbance or biotic succession

Cover/shelter has structural and micro climatic components. The structural components that matter the wild animals cover requirements include:- vegetation type (grass, forbs, shrubs, trees); vegetation density; snow or water depth; topography, slope, aspect; and suitability of soil for digging dens/burrows, etc. The microclimate components may include temperature, humidity, wind, light intensity, etc.

### **Home range**

Much of the activity of animals will center on some favoured feeding ground or place where they rest or sleep or perhaps a patch of cover in which they feel secure from enemies. This area in which an individual animal spend all, or most of, its time is known as its home range. The animal is advantageous in spending as little energy as possible in search of food and in knowing just where to hide if a predator appears, or in having a familiar place to avoid extremes of weather or insect attacks. Size and number of home ranges vary among animals as follows:

- Sedentary animals may have only one home range
- Some species normally have several home ranges that are used seasonally
- Carnivores have larger home ranges than do herbivores of the same size
- Male individuals often have larger home ranges than females
- Home ranges can be very much reduced in some seasons e.g. when demands of reproduction tie animals to nest
- Home ranges need to be smaller in good habitat than in poor habitat because animals do not have to travel so far to fulfill their needs

### **2.4. Breeding site**

Breeding site is the place/areas where wildlife can build a den, nest, or dig a burrow to give birth and raise young. Destruction and fragmentation or total loss of the breeding sites of the wild animals affects not only their food and other resources but also their breeding ground which influence their population size. For instance, fragmentation of breeding habitat and nesting failures in the summer nesting grounds of the United States and Canada have had a major negative impact on the breeding of woodland Songbirds. As woodlands are broken up by roads and developments, it is becoming increasingly difficult to find enough contiguous woods to nest successfully for those birds. Sometimes it may appear that the habitat provides everything

wildlife needs to survive and prosper, yet the population never seems to increase. This failure to increase in numbers may be related to a lack of breeding sites.

## UNIT THREE: THREATS TO WILDLIFE

### Introduction

The threat of a species does not differ in kind. The species goes extinct due to the presence of various threats. Living things face a constant barrage of external stresses or threats that challenge their ability to survive and reproduce. If a species is unable to successfully cope with these threats through adaptation, it may face extinction. Thus, wild animals have to cope not only with predictable characteristics of the environment such as seasonal changes in climate and resource availability, but also with a variety of unpredictable events, including human disturbances, which have tended to be on the increasing side in most ecosystems worldwide. A constantly changing physical environment requires organisms to adapt to new temperatures, climates, and atmospheric conditions. Living things must also deal with unexpected events such as volcanic eruptions, earthquakes, meteor strikes, fires, and hurricanes/storms and interact with living organisms are further challenged to their survival such as competition, predation, parasitism, disease, and other complex biotic processes. Let us describe how to detect such problems and how to treat a species from danger. The major wildlife threats are grouped in to natural and anthropogenic factors.

**A) Natural factors:** Natural factor is a factor which causes threats to wildlife naturally without human disturbance. These include:-

- **Demographic uncertainty:**-uncertainty results from the effects of random selection e.g. extremely skewed sex ratio.
- **Environmental uncertainty:** - refers to unpredictable events like change in weather or food supply, populations of competitors and natural catastrophes.
- **Genetic uncertainty:**- it is random variation in the gene frequencies of a population due to some genetic variance and uncommon alleles are likely to be lost diversity due to *Genetic drift, Inbreeding*.

- **Soil erosion:** - it is resulted by wind or water action. The impact of such erosion is loss of top soil (wind) and Terrain deformation (water). Usually where soil is poorest, species will be fewest, etc.

## **B) Anthropogenic factors**

An anthropogenic factor is the main threat for wildlife that is caused by human. Human uses wildlife as well as their habitats for various purposes. For example, hunting of rhino for their horn, leopard for its attractive skin and elephant for its ivory and destroyed their habitats for cultivation and various infrastructure (like road, railway etc). Some of the anthropogenic factors include:-

- **Increasing number of livestock:** Ethiopia is famous for its livestock in Africa. The increase in number of livestock demands to more areas for grazing, competition with wild animals for limiting grazing/water and may lead to hybridization with wild one. For example the endemic Ethiopian wolf living together with dogs and hybridized in Bale Mountain National Park and Menz Gausa Community Conservation Area. This is results for the loss and decreased the number of endemic Ethiopian wolf in the area.
- **Habitat Destruction & Fragmentation** - The destruction or splitting up of once continuous habitat to enable humans to use the land for agriculture, development of towns and cities, construction of dams, or other purposes.
- **Climate Change** - Human activities such as the burning of fossil fuels have altered the Earth's atmosphere and have resulted in global climate changes.
- **Introduction of Exotic Species** - Accidental and intentional introduction of non-native species into regions never before occupied by the species have resulted in the extinction of numerous endemic species.
- **Pollution** - Pollutants (pesticides, herbicides, etc.) released into the environment are ingested by a wide variety of organisms.
- **Over-Exploitation of Resources** - Exploitation of wild populations for food has resulted in population crashes (over-fishing, for example).
- **Accidental Deaths** - Car hits, window collisions (birds), collisions with ships (whales). Wild animals are no more exempted from accidents than people are. Fire, drowning, falls, highway collisions, and the like can all cause accidental death. As population increase in size and more
- **Illegal hunting and wild life trade:** In Ethiopia, wild animals are hunted for the following four major reasons:

- For traditional medicine – wild ass
- For fame, to be considered as a hero
- For clothing
- Civil war

Political instability allow better access to automatic weapons, bullets and the use of area as military camps which usually led to migration of wild animals and hunting of wild animals.

### **3.1. Habitat degradation, loss and fragmentation**

A habitat is the physical and biological environment used by an individual, population and species. The group of what does “wild life habitat” means if virtually every environment supports wild organisms? Even a parking lot will have microbes and small invertebrates living in the cracks in the pavement. An ecosystem is a group of organisms and their physical environment, such as a lake or a forest serves as to the habitat of a species. Habitat might include the forest, lake, and a bark of tree. We can also understand the difference between degradation and loss of habitats.

#### **3.1.1. Habitat degradation and loss**

It is the process by which habitat quality for a given species is diminished: for example, when contaminants reduce a species’ ability to reproduce in an area. When habitat quality is so low that the environment is no longer usable by a given species, then *habitat loss* has occurred. The line between habitat degradation and loss will often be unclear. For example, if environmental changes prevent a species from reproducing, but some individuals can still be found (e.g. dispersing juvenile animals, or a few old trees that survive, but whose seeds never survive), is this habitat loss or severe degradation? Sometimes, these differences can be clarified if we describe the types of habitat use more explicitly: for example, by referring to breeding habitat, foraging habitat and winter habitat. Habitat loss or degradation for one species will probably constitute habitat gain or enhancement for some other species. For example, cutting a forest is likely to degrade or destroy habitat for a squirrel, but the resulting early succession ecosystem is likely to be new habitat for at least one butterfly species.

#### **Types of habitat degradation/loss**

There are many ways that leads to habitat degradation and loss in a natural environment. Some of the ways are discussed below.

**i, Contamination**

One might define a pollutant or contaminant as a substance that is found where we do not want it to be. In other words, pollutants or contaminants are substances which degrade the habitat of wild life in the natural environment. These pollutants or substances often do not fixed in one place; they move from place to places or habitat to habitat for the decreased of habitat quality. There are three main media that can move pollutants. These are air, water, and living organisms and we will focus on air pollution, water pollution, and pesticides.

**A) Air pollution**

Every day huge quantities of materials are lofted into the atmosphere from our vehicles, factories, and homes. Nitrogen oxides and sulfur oxides combine with water to form nitric and sulfuric acids, the basis of acid rain. Chlorofluorocarbons (CFCs) and halogens rise to the upper atmosphere, where they reduce the concentration of ozone, allowing more harmful ultraviolet radiation to reach the earth's surface. Closer to earth, ozone and a suite of other chemicals form toxic clouds called smog. The effects of air pollution on wild species, but given the basic similarity in the physiology of domestic and wild species, it is likely that they are also affected. Certainly severe air pollution has even killed the majority of animal's species. No doubt many animal species also become locally extinct in these zones, but it would be hard to know if they were directly eliminated by air pollution or simply disappeared because of the loss of plant species.

Even moderate levels of air pollution are known to eradicate many lichen species; in fact this relationship is so well documented that lichens are widely used to monitor air pollution. Chronic effects that diminish an individual's health and vigor, and thereby reduce reproductive success or longevity, are probably more common than acute effects that kill organisms directly. Even species living far from the source of air pollution may be affected. The declines of some remote amphibian populations might be linked to air pollution because of its effects on the acidity of aquatic ecosystems, global climate, pesticides, and ultraviolet radiation. For example, some research indicates that certain amphibian species, especially those living at high altitudes, are vulnerable to ultraviolet-B radiation.

**B) Water pollution**

Some substances and chemicals are pollute the aquatic ecosystems such as nitrates and phosphates that are important nutrients for aquatic plants, but can lead to an excessive growth of

plants, upsetting the balance of an aquatic ecosystem. On the other hand, there are chemicals such as dioxin that endanger life at concentrations so low that they are measured in parts per billion. Some pollutants are routinely discharged into aquatic ecosystems from factories and sewage treatment plants. Others enter in a catastrophic deluge after an accident such as the rupture of an oil tanker. Still others, such as sediments, pesticides, and fertilizers, often seep in gradually, carried by the runoff from our agricultural fields, lawns, and streets.

When pollutants originate from broad areas, these places are called *non point sources*, in contrast to specific sites (e.g. factories), which are called *point sources*. Aquatic species and ecosystems are more threatened by water pollution than are terrestrial biota. On a local scale, there are many lakes, streams, rivers, and bays where water pollution has eliminated so many species that it would be fair to say that the aquatic ecosystem has been destroyed, even though a body of water and a handful of species remain.

Elimination of a species from a single water body may mean global extinction because many aquatic species are found in a single lake or river system, having evolved in isolation from their relatives in nearby water bodies. One of the most interesting examples of this comes from Lake Victoria in East Africa, home to hundreds of endemic cichlid fish species. Separation among these closely related species is highly dependent on females choosing mates of the correct species; however, with growing eutrophication the lake's turbidity is increasing, and the females cannot distinguish the colors they need to see to choose the correct mates. Consequently, cichlid diversity is declining in eutrophic areas of the lake.

In contrast, water pollution is less likely to cause global extinction of species in marine ecosystems than in freshwater ecosystems because marine ecosystems are often too large to pollute in their entirety and because many marine species have large geographic ranges, making it less likely that their entire range would be so polluted as to be uninhabitable. Even though water pollution may not be responsible for the global extinction of marine species, it still can have a profound impact on marine biodiversity, particularly through local extirpations: for example, when coral reefs are smothered in silt or overrun with macroalgae because of excessive nutrients and eutrophication. Water pollution can also upset the equilibrium of marine food webs, such as when an excess of nutrients causes an explosive growth of toxin-producing plankton known as "harmful algal blooms".

### C) Pesticides

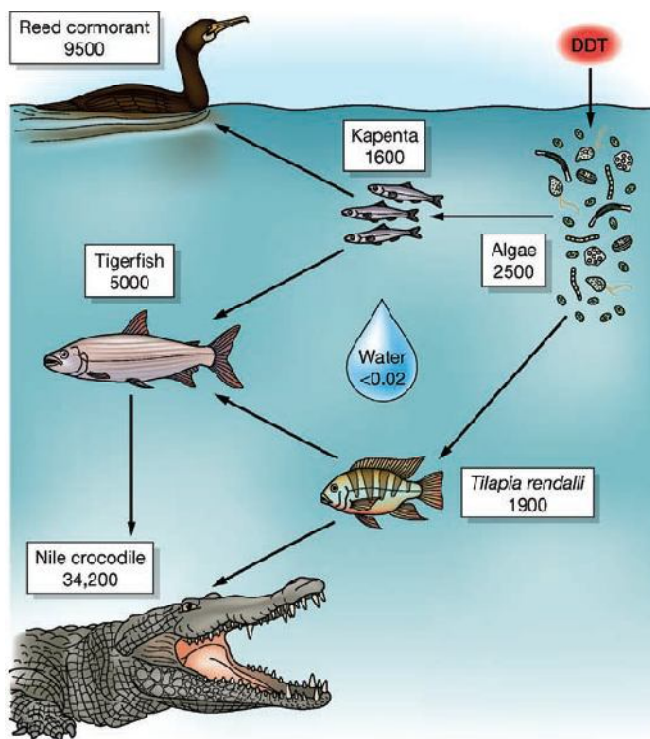
To capture a large portion of the earth's resources people must compete against other organisms, and pesticides are one of our preferred tools for doing this. The use of high quantities of insecticides and rodenticides to kill animals that would eat our crops, herbicides to kill plants that would compete with our crop plants, and fungicides to kill fungi that would decompose our food and fiber. Worldwide, over 50,000 different pesticide products with active ingredients weighing over 2.6 million metric tons are used each year. Some of these pesticides are relatively benign. They kill only a small group of target organisms, they are used in limited areas (e.g. food storage facilities), and after use they quickly break down into harmless chemicals. Unfortunately, very few pesticides meet all these criteria, and some, such as the notorious DDT, wreak havoc on a broad set of non target organisms for a long period over large areas.

The most famous example involves a set of chemicals known as chlorinated hydrocarbons (which includes DDT, many other pesticides, and some chemicals that are not pesticides, such as PCBs, polychlorinated biphenyls). They are soluble in fat and can take years, even decades, to break down. This means that they pass from prey to predators up a food chain and can concentrate in top predators, a process known as *biomagnifications*. Populations of several predatory birds (ospreys, brown pelicans, bald eagles, peregrines, and others) were dramatically reduced by chlorinated hydrocarbons during the 1950s and 1960s. Use of these chemicals has been sharply curtailed in many wealthier countries, and this has allowed populations of these birds to recover somewhat. However, use of chlorinated hydrocarbon pesticides continues in many less-developed countries, and, because of their persistence, a wide variety of chlorinated hydrocarbons continues to contaminate the environment of places where they have been. The negative effects of pesticides typically focus on species that are most similar to birds and mammals because it tend to be more concerned about their welfare, and because toxic effects on these species may portend toxic effects on us. However, it is likely that the most serious effects of pesticides fall on organisms that are most closely related to the target species.

Persistent pesticides and similar compounds accumulate in the tissues of one species and then are passed up the food web to other species where they become more concentrated. This process is called bio-magnification or bio-amplification. For example, (fig. 1), in aquatic habitat DDT has entered in to the food web of Lake Kariba in Zimbabwe and reached its highest levels in top



predators such as crocodiles, tiger fish, and cormorants. Numbers are parts per billion of DDT and its derivatives in the fat of the species illustrated.



**Figure 1.** This figure shows how DDT entered in the food web and reached its highest levels in top predators

## ii, The Human infrastructures

Flying in a plane, you can easily see the hand of humanity; most landscapes are crisscrossed with roads, railroads, fences, and utility corridors and dotted with buildings, dams, mines, parking lots, and many other structures. The total area covered by such structures is significant (about 3 million km<sup>2</sup> worldwide; over 2% of the land area and represents a loss of habitat for virtually all wild species. Looking beyond the immediate footprint of these structures, one can see that a much larger area is affected. For example, roads and their adjacent impact zones cover an estimated 20% of the area of the United States. Thus, we can list “construction of human infrastructure” along with deforestation, and other processes that destroy entire ecosystems. In this section we will focus on the consequences of adding these and other structures to the biota of entire landscapes, especially on animals that move across landscapes.

**A) Roads**

The most ubiquitous structures created by people are roads, and while roads facilitate the movement of people, they can also serve as impediments to the movements of many animals. Some roads have curbs or lane dividers that are an absolute barrier to small, flightless animals such as amphibians, small reptiles, and various invertebrates. Most of the individual animals killed on roads may be of common species that are in no danger of extinction, but even a few road deaths can be of great consequence for an endangered species (fig. 2). For some species roads are a psychological filter; individuals are apparently reluctant to cross them even though physically capable of doing so. In the Brazilian Amazon some bird species, especially those found in the understory of interior forests, very rarely crossed roads, even roads where re-growth formed a nearly intact canopy over the road.

If organisms are unable or unwilling to cross a road, then the populations on either side of the road may become isolated from one another; this has been demonstrated for amphibians and beetles. A second major problem associated with roads is the access they provide to people who may overexploit organisms or destroy whole ecosystems. The roads penetrating formerly remote areas of tropical forest, allowing access by poachers who overexploit game populations and settlers who raze the tropical forests, are a particularly terrible example of this phenomenon. The effect of road access on habitat quality has been well studied for some large carnivores such as wolves and tigers. Roads may also provide access to exotic organisms that can disrupt native populations. Usually, these will be species carried, intentionally or not, by people traveling along the highway. Sometimes, exotic species will move along the road by themselves. In particular, weedy exotic plants seem to use the disturbed ground of roadsides to invade a landscape. Finally, roads have a variety of physical and chemical attributes that are likely to affect adjacent aquatic and terrestrial ecosystems. These include various substances such as dust, sediment, salt, heavy metals, hydrocarbons; a sunny, windy, warm microclimate; blocking surface water runoff; and more.



**Figure 2.** An example of death of wild animals by car accident

### **B) Dams**

Worldwide, over 45,000 large dams (>15 meters high) have affected most of the world's major river systems. The damming of streams and rivers destroys many aquatic ecosystems, flooding ecosystems upstream of the dam and changing water flows to downstream ecosystems. Many animals move up and down rivers during the course of a year, or during their life cycle, searching for the best places to forage or breed. Some of them can fly or walk around dams (otters, mergansers, mayflies, etc.), but for totally aquatic species dams can be very significant barriers. Moving downstream these animals are likely leads to death or at least highly stressed in turbines. Mostly fish are the best known victims of dams, especially anadromous fish such as salmon that move long distances between riverine spawning areas and marine foraging areas. Some salmon populations have been completely eliminated, largely by dams, despite millions of dollars spent building fish ways. In addition to aquatic animals, shoreline plants are also effects by dams and reservoirs on shaped by dispersal issues: water-dispersed species with a limited ability to float were strongly affected by damming.

### **C) Fences and other similar constructions**

Some landscapes are dissected by barriers specifically designed to inhibit the movement of animals. Notably, rangeland fences stretch huge distances, controlling the movement of both

livestock and large wild mammals and sometimes severing seasonal migrations. For example, in Botswana, thousands of kilometers of fences have been erected to isolate livestock from wild ungulates that might harbor diseases. These fences have had catastrophic consequences for native ungulates, especially wildebeest that must migrate to access water during dry seasons. Most bird species can readily fly over human-made barriers, although some forest birds are very reluctant to venture into the open, and some of the large, flightless birds (e.g. emus and ostriches) are easily stopped by fences. Unfortunately, birds are often killed by flying into human structures. Large numbers of migrating birds collide with power lines, antennas, lighthouses, windmills, and similar structures; even local movements can result in a collision with a large window.

#### **D) Trashes and Other Things**

Much of this material is trash, things discarded by people, perhaps intentionally or perhaps not. Lost or discarded fishing gear is a major hazard for aquatic animals. The worst offenders are probably lost gill nets – often called ghost nets – which can drift for months or years, still catching fish, diving birds, seals, and other creatures. It is difficult to estimate the extent of this mortality, but with about 21,300 km of nets (enough to reach more than halfway around the world) set nightly to catch salmon and squid in the North Pacific alone, the total loss is likely to be enormous. Fishing sinkers made of lead and lead shot discharged by waterfowl hunters accumulate on the bottoms of water bodies, where they are likely to be swallowed by bottom-feeding birds and cause lead poisoning. One of the major causes of death among sea turtles appears to be ingesting marine debris, especially plastic bags and balloons that they mistake for jellyfish. Some of the problems we cause by putting human-made objects into natural environments would be hard to predict. Consider a seemingly innocuous item, red plastic insulators for electric fences. It turns out that large numbers of hummingbirds mistook the insulators for flowers and electrocuted themselves until the manufacturer withdrew the product. Generally, we can list various form of wildlife threats such as some flight birds crushing with plants, colliding with animals. In deserts and on beaches off-road vehicles are a threat to sedentary or slow-moving species such as hatchling birds, and desert tortoises.

#### **iii, Deforestation**

Many conservation biologists believe that deforestation may be the most important direct threat to biodiversity because forests cover less than 6% of the earth's total surface area, forests are

habitat for a majority of the earth's known species and forests are being lost faster than they are growing.

### **A) Causes of Deforestation**

Forests tend to grow in places with reasonably fertile soils and benign climates, not too dry and not too cold. These also tend to be good places for people to live and grow crops. Consequently, millions of square kilometers of forests have been removed to make way for our agriculture, homes, businesses, mines, and reservoirs since the beginning of agriculture. This process has slowed, stopped, or even reversed in some areas that were extensively deforested many years ago, such as Europe, China, and eastern North America. In some developed countries, the demand for forest land is less because the human population has stabilized, or because the local economy has shifted from agriculture (the single biggest cause of deforestation) to industry. In other places, such as large parts of China, there are simply few forests left to remove. Unfortunately, deforestation continues at an alarming pace in many tropical regions. The statistics vary widely – an area the size of Switzerland every year, nearly 50,000 ha every day, and so on – and we do not really have a good estimate, but the basic fact remains: forests are disappearing, especially tropical forests.

The fundamental reasons for the current spate of tropical deforestation are threefold. First, human populations are increasing rapidly in most tropical areas. Second, many of these people are poor, and clearing forest to open a small plot where crops can be grown is often their only choice for survival. Third, corporations and wealthy individuals cut forests for wood products with inadequate attention to regrowth (especially in Asia) and to open the land for cattle ranching (especially in Latin America). Unfortunately, poor farmers are often trapped in poverty because the lands they clear are not really suitable for agriculture in the first place. After only a few years the soil's fertility is drained, and they must move on to another site and clear more forest.

The process of clearing a small patch of tropical forest, growing crops for a few years, and then moving on to another site is called shifting cultivation and it is a traditional, sustainable practice when human populations are low and the abandoned site is allowed to return to forest. However, when populations are too high, then people stay at a site too long or return to a previously used site too soon. Alternatively, they may sell the land to a wealthy cattle rancher. Particularly in Latin America, much of the tropical forest initially cleared for subsistence agriculture ends up as

rangeland for cattle, while under some circumstances the cattle ranchers destroy the forest themselves. In Asia, the direct drivers of deforestation are often logging companies.

Whatever the underlying reason, abusive use of a site is likely to degrade the soil so badly that, even when it is abandoned, it will probably take several centuries, or even millennia, for a rich forest to return. Tropical forest soils are notorious for being easily degraded and difficult to reforest. In many people's eyes timber harvesting is a major cause of deforestation.

### **B) Consequences of Deforestation**

Needless to say, when people convert a forest to another type of ecosystem, most of the forest-dependent species are lost from that site for some period. It is easy to name forest dwelling species that are threatened with extinction largely because of deforestation –giant pandas, tigers, gorillas, and many more. With most of the earth's biodiversity residing in insects and other small organisms, and with many, perhaps most, of these small species living in tropical forests where they remain unknown to science, we can only make gross estimates of the likely impact of deforestation. Fully acknowledging the extent of our uncertainty, it is still clear that a large portion of the earth's biodiversity is found in tropical forests and that these forests are being lost to deforestation at a very high rate. Consequently, all conservation biologists believe that protection of tropical forests must be a high priority.

So far we have focused on the biological consequences of deforestation, but through changes in the physical environment, deforestation can have effects far beyond the edge of the forest. We have already discussed soil erosion as a source of sediment that can contaminate aquatic ecosystems. On a global scale, forests affect the earth's climate by acting as reservoirs of carbon, and when they are cut, much of the carbon moves into the atmosphere as carbon dioxide, the major greenhouse gas. More locally, because much of the water vapor in the atmosphere above a forest is maintained by evaporation and transpiration, when a forest is cut, rainfall may decrease. This makes the hot, dry conditions of a deforested site even hotter and drier.

#### **3.1.2. Habitat Fragmentation**

The process by which a natural landscape is broken up into small parcels of natural ecosystems, isolated from one another in a matrix of lands dominated by human activities, is called *fragmentation*. Because fragmentation almost always involves both loss and isolation of

ecosystems, researchers would like to distinguish between the effects of these two processes but it is not often practical to do so. Fragmentation is a major focal point for conservation biologists, both because it has degraded many landscapes and because many nature reserves have become isolated fragments or are in danger of becoming so.

### **A) Fragment Size and Isolation**

There are three main reasons why large fragments have more species than small fragments. First, a large fragment will almost always have a greater variety of environments than a small fragment (e.g. different types of soil, a stream, a rock outcrop, an area recently disturbed by fire), and each of these will provide niches for some additional species. Second, a large fragment is likely to have both common species and uncommon species (i.e. species that occur at low densities), but a small fragment is likely to have only common species. This idea is easy to grasp when we consider species that have large home ranges; for example, it means that we are unlikely to find a bear in a tiny fragment.

However, it also applies to species that have rather limited home ranges but still actively avoid small fragments. For example, certain small birds such as Sprague's pipits and grasshopper sparrows have home ranges of only a few hectares, but are usually not found in habitat fragments less than 100 ha in size. Species that do not occur in small patches of habitat are called *area-sensitive species* and are often of concern to conservationists. Furthermore, uncommon species that are not area-sensitive (i.e. that can find habitat in a small fragment) are also unlikely to occur in a small patch by chance alone. Third, small fragments will, on average, have smaller populations of any given species than large islands, and a small population is more susceptible to becoming extinct than a large population.

### **B) Causes of Fragmentation**

The fundamental cause of fragmentation is expanding human populations converting natural ecosystems into human-dominated ecosystems. Fragmentation typically begins when people dissect a natural landscape with roads and then perforate it by converting some natural ecosystems into human-dominated ones. It culminates with natural ecosystems reduced to tiny, isolated parcels. Thus, fragmentation almost always involves both reducing the area of natural ecosystems and increasing their isolation. As the single largest user of land, agriculture is the



proximate cause of most fragmentation. Certainly, for many terrestrial species, a large expanse of cropland is a barrier nearly as effective as a stretch of water.

### **C) Consequences of Fragmentation**

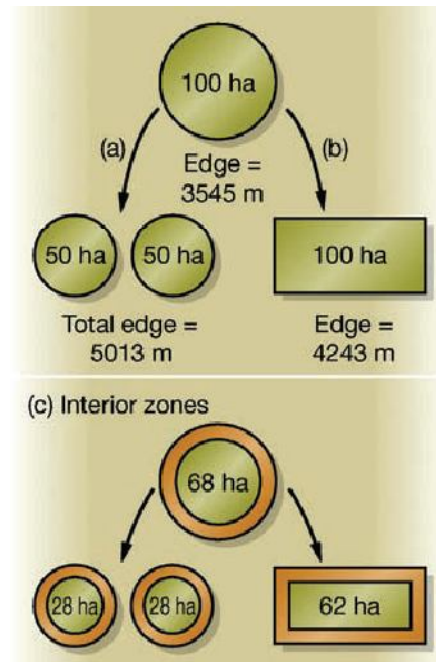
Ecosystem destruction is the driving force behind fragmentation, and thus it is inevitable that fragmentation is associated with negative effects on biodiversity. Notably, remnant ecosystems that seem to have escaped destruction may no longer be available for area-sensitive species that cannot use small patches of habitat. Most prominent among these are large predators that need extensive home ranges to find enough prey. Some small species with limited home ranges also avoid small habitat patches: for example, birds and beetles. This may occur because they require the microclimate characteristic of the interior of large habitat patches, or because they select habitat patches large enough to support other members of their species, or because of their interactions with other biota as predators, prey, or competitors.

In highly fragmented landscapes, it is difficult for individuals (usually juvenile animals, seeds, or spores) to disperse to another suitable patch of habitat. If immigration and emigration are very limited, then the individuals occupying a fragment may effect populations are more likely to disappear. Furthermore, if a population does disappear, a low immigration rate will mean it takes much longer to establish a new population. Even if fragmentation only leads to partial isolation, this may change one large population into a metapopulation, which may also affect population viability and persistence. The dispersal of fire is also an issue; fragmentation has greatly disrupted natural fire regimes in regions where fires once swept across the landscape. The migration of animal species that travel between habitats seasonally could be impeded by fragmentation. In practice, this is likely to be a problem mainly for species that walk, such as large mammals that travel up and down mountains in spring and autumn, or amphibians that migrate to and from spring breeding pools.

Finally, one consequence of fragmentation is based on a simple rule of geometry: the perimeter length of a patch changes as a linear function, whereas its area changes as a square function. This means that as fragmentation makes patches smaller and smaller, their ratio of edge to interior increases disproportionately (Fig. 3). Similarly, if we define a zone in the patch that is within a certain distance of the patch's edge, the relative area of this edge zone will also increase disproportionately as the patch gets smaller. Finally, although fragmentation does not necessarily



affect the shape of a patch, it should be noted that another rule of geometry (a circle is the shape with the shortest perimeter) means that the further a patch's shape departs from circular, the longer its edge will be.



**Figure 3.** Three principles of geometry that affect the edge-to area ratios of patches. (a) Small patches have relatively longer edges than large patches. (b) Patches that are less circular in shape have longer edges than circular patches. (c) The interior zone of a small or noncircular patch is relatively small compared with that of a large, circular patch.

## 3.2. Overexploitation

### 3.2.1. The long history of overexploitation

After the most recent glaciations the grasslands of central North America harbored an extraordinary array of large mammals. The diversity of antelopes, horses, cheetahs, giant ground sloths, mammoths, and others easily rivaled the large mammal fauna of Africa today. However, about 11,000 years ago, at the end of the Pleistocene epoch, they disappeared; 34 genera of large mammals became extinct in less than 1000 years, while 40 more became extinct in South America. This is a massive die-off when you consider that only 20 large mammal genera had become extinct in North America over the previous three *million* years. Nevertheless, it seems highly likely that overhunting was more important than climate change because the same story – humans arrive, large animals go extinct – has now been told in many other locations where climate change was clearly not responsible.

The best evidence that overhunting by early people has eliminated some species comes from islands. On many remote islands, birds evolved in the absence of mammalian predators, sometimes losing their ability to fly in the process. When people arrived on these islands, they found easy prey. For example, when Polynesians, now known as Maoris, arrived in New Zealand in about 1200 CE, the islands had 11 species of moas, a group of flightless birds ranging in size from a turkey to far larger than an ostrich. By the time Europeans colonized the islands in the eighteenth century, the moas were all gone. Indeed, some evidence suggests that all the moas were extinct less than 100 years after Polynesian colonization. On small islands throughout the Pacific, scores of birds are known to have become extinct after the arrival of Polynesians.



**Figure 4.** Many scientists believe that human overexploitation was responsible for the extinction of many large North American mammals about 11,000 years ago. The woolly mammoth depicted here was apparently one victim, although the caribou shown in the background continues to survive.

The word overexploitation defined as human overuse of a population of wildlife to an extent that threatens its viability or significantly alters the natural community in which it lives. Currently, there are two forms of overexploitation that receive the most attention from conservationists are overfishing and “bushmeat” trade. Overfishing means the overuse of fishes or aquatic organisms. Overfishing does not attract adequate public scrutiny for many reasons including: (1) people are not very sympathetic to fish; (2) most fishing happens at sea, beyond sight and often beyond national boundaries; and (3) the total harvest across all fisheries has only recently started to decline.

The term “bushmeat” can be widely construed to cover any wild animal used for human food, but in the word list of conservation it is used primarily when describing the overexploitation of animals in tropical terrestrial ecosystems, especially in forests, and especially in West and Central Africa. The range of animals involved is enormous – from crabs to gorillas – but mammals dominate especially rodents, ungulates, and primates. Of course people have been hunting and eating wild animals in tropical forests for millennia, but the rate of exploitation has clearly become unsustainable in recent decades as the density of people has grown and as exploitation has been driven by commercial enterprises rather than local, subsistence consumption. Bushmeat overexploitation carries profound risks for people as well as wild animals.

### **3.2.2. Types of exploitation**

#### **i, Commercial Exploitation**

Money “makes the world go round” and is the driving force behind most exploitation of wild life. Significant sums of money are involved because of the importance and diversity of products obtained: food, fiber, fuel, medicine, building materials, and more. In practice, the scale of commercial exploitation of wild creatures ranges from children selling berries by the roadside on a Saturday afternoon to some of the world’s largest multinational corporations logging trees and government-owned fleets combing the seas for fish. Unfortunately, commercial exploitation of wild life can easily become overexploitation for at least eight reasons.

- a. The potential market for wild products is enormous.** In global economy, a wild product enters commerce; there are over six billion potential consumers. The major markets for rhino horns and elephant ivory obtained in Africa are in the Far East; coral collected in the Philippines is destined for Europe and North America; bear gall bladders from the United States are extracted for Chinese markets.
- b. People who exploit wild life for financial gain, like almost everyone else, have an enormous desire for wealth.** First, they need food, clothing, and shelter; then a car, a second car, and a second home; and then status and power become priorities. This is in sharp contrast to subsistence-based exploitation.
- c. Domestic substitutes for wild products are not identical and often sell for less.** People usually prefer wild berries over cultivated ones, wild (slowly grown) wood over plantation-

grown wood, venison over beef, and pheasants over chickens, and this translates into higher prices for the wild products.

- d. **The market price of a wild species usually increases as it becomes rarer**, and this will greater exploitation and will make the wild species even rarer. For example, at the end of the nineteenth century the demand for hat feathers pushed egrets into the most remote regions of the southeastern United States, but hunters pursued them relentlessly as the price of decorative plumes rose to twice their weight in gold.
- e. **Wild resources are often communal resources**, owned by no one and everyone. This means that the costs of overexploitation are shared by many people, not just the person who is abusing the resource, while the benefits are obtained by the exploiter. This is called the “Tragedy of the Commons.” This dilemma commonly applies to aquatic species because individuals do not usually own the wild life of lakes and seas, whereas in terrestrial systems land owners usually own the plants and sometimes the animals. In many countries the major landowner is the government (national, regional, or local), and the private individual is relatively free to overexploit.
- f. **Wild life is often found in remote places** where laws and social constraints do not operate effectively. It is much easier to use wild life irresponsibly on the high seas or in a remote forest than under public scrutiny.
- g. **Commercial exploiters often have the capital** to purchase expensive technology for collecting wild life in large quantities: for example, seagoing vessels for fishing and whaling, logging machinery, and even helicopters with which to poach elephants and rhinos. Sometimes these are paid for by earlier profits, sometimes by government subsidies.
- h. **The disparity among national currencies makes it profitable to exploit rare species around the world.** Expansion of the global marketplace through increased transportation and lowering of trade barriers means that overexploitation is likely to occur whenever there is a large difference in the buying power of currencies.

## ii, Subsistence Exploitation

Most rural people exploit wild life to directly meet some portion of their personal needs for food, clothing, fuel, and shelter. Among some rural people – especially those who are more affluent these activities, like a Saturday spent fishing or gathering mushrooms, are just supplemental to the household economy. They are motivated primarily by recreational needs and secondarily by subsistence needs. At the other end of the continuum, some rural people obtain virtually all of

their life requisites by gathering and hunting wild species. Worldwide, most rural people fall in the middle of this range, obtaining a moderate portion of their needs from the wild, especially fuel and building materials, and the remainder from markets and subsistence agriculture. In contrast to commercial exploitation, the scale of subsistence exploitation is limited by the number of people living in places where they have access to wild life and by their levels of consumption. This is not to say that subsistence use cannot lead to overexploitation (witness the moas), only that it is less likely to lead to overexploitation than commercial use.

### **iii, Recreational Exploitation**

Many people routinely use wild life just for the fun of it. For example, among adults in the United States 36% use wild animals recreationally; i.e. there are an estimated 13 million hunters, 34 million anglers, and 66 million “wildlife watchers” (people who participate in outdoor activities that focus on viewing wild animals). When we think about recreational exploitation of wild creatures, hunting and fishing come to mind first, perhaps because killing animals is considered the ultimate form of exploitation. Funds spent by hunters and anglers for lodging, food, and guide services can go a long way toward developing local support for conservation in rural areas, especially in developing nations. Hunting has become a necessity for controlling some populations, notably deer, in the absence of natural predators. Incidentally, some of the worst cases of overexploitation come from hunters who pursue smaller prey such as butterflies, mollusks, and orchids. Naturalist collectors are notorious for going to great lengths to add rare species to their collections.

### **iv. Incidental exploitation**

Not all exploitation is deliberate; often in the process of exploiting one species, other species are incidentally exploited as well. This phenomenon is so common in fishing that there is a specific term for this unintentional mortality: *by catch*. The best known example of this involves setting nets around schools of tuna and drowning dolphins in the process, a practice that has been sharply curtailed because the popularity of dolphins led to legal actions. Unfortunately, other forms of fishing continue to kill many unintended victims; indeed, incidental mortality in gill nets is the major threat to the world’s most endangered marine cetacean, Mexico’s vaquita and some albatross species are severely threatened by being hooked and drowned during long-line fishing. Traps on land can also be nondiscriminating; for example, gorillas are occasionally

caught in snares set to catch duikers (small forest antelopes), and giant pandas are caught in musk deer snares.

#### **v. Indirect Exploitation**

The term “indirect exploitation” could be used to cover a wide set of human activities that indirectly kill other organisms: such as the roads, fences, antennas, and others are cause for threats wildlife. And also the introductions of exotic species are indirectly killing other organisms.

#### **3.2.3. Consequences of overexploitation**

The most basic consequence of overexploitation is removal of many individuals from a population. But, not all the individuals in a population are equally susceptible to exploitation; their vulnerability may be influenced by their size, age, sex, phenotype, where they are, and when they are there. Consequently, the structure of a population, particularly its age, sex, and genetic composition, can be changed by exploitation.

##### **A) Age**

In many fisheries, the most profitable fish to catch are the largest, oldest individuals, but these individuals also have the highest reproductive capacity. Consequently, the effects of overfishing are exacerbated because decisions on when and where to fish and what kinds of equipment to use (e.g. net mesh size) are often directed toward the most fecund members of the population. The fact that this pattern of mortality is very different from natural mortality is especially worrying.

##### **B) Sex**

Among many mammal species, males are more exploited than females because they are bigger, more desirable and they are often traveling over larger areas, making contact with people more likely. Consequently, exploited mammal populations often have a sex ratio that is skewed toward females. The effect on population viability may be modest because most mammals are polygynous (i.e. one male will mate with multiple females), but there could be important exceptions. Off the west coast of South America, preferential hunting for male sperm whales led to a shortage of males that still persisted nearly 20 years after whaling ended. More importantly, this shortage of males was blamed for the low pregnancy rate among females. Some population modeling has also shown that skewed sex ratios can jeopardize a population.

### **C) Genetic Structure**

Preferential harvest can also act as a form of artificial selection and change the genetic makeup of a population. For example, some forests are subjected to a form of overexploitation called high-grading in which the best trees (e.g. those having the best form) are cut and the worst (e.g. diseased individuals) are left behind. It is widely assumed that high-grading is likely to alter a population's genetic structure to some degree, but, surprisingly, this issue has received relatively little attention from forest geneticists. Overfishing has altered the genetic structure of many salmon populations by allowing some small males, which spend little or no time foraging at sea and thus are less likely to be caught by commercial fishing vessels, to become a large portion of the population. These small males are able to pass on their genes by "sneaking" access to females rather than fighting for access with the large males that have returned from the sea. Game managers have expressed concern that the selective nature of trophy hunting could change the genetic structure of populations and at least one clear example has been documented: trophy hunting for bighorn sheep reduced the population's horn size and body weight of males, two traits with a high degree of heritability.

### **3.3. Lack of resources (food and water)**

Everyone can appreciate that food is necessary for wildlife, but few landowners understand the difference between starvation and malnutrition. This is related to our perception that food appears to be available, yet food-related problems begin appearing in wildlife populations. Wild animals die from starvation because they do not get enough food to survive (a lack of food quantity). Carnivores typically die because they cannot catch enough to eat. If something has happened to reduce or eliminate rabbit or small mammal populations in an area, a red fox living in that region may starve. Animals die from malnutrition because they cannot find food that meets their nutritional needs (a lack of food quality). Plant eaters sometimes suffer because of malnutrition. Deer in South Carolina usually do not die because they cannot find enough to eat. Their overall health deteriorates or they may perish because what they eat is either not nutritious enough to maintain their bodies or not able to meet the demands put on them by reproduction or mating.

Although the woods and fields may look green and be covered with lush plants, this does not mean deer and other herbivores have adequate food. A key to managing food for herbivores becomes one of matching the animals' food habits and needs with what the land can provide. Winter malnutrition can adversely affect the next generation of young animals. Young, growing



animals require more protein than adults. While milk supplies the protein needed by newly-born mammals, young carnivores often supplement the demand for protein with meat. For young herbivores, an adequate supply of milk is a necessity. Plant communities influence the likelihood of malnutrition for the animals in the area.

Eliminating plants with high nutritional value can have just as devastating impact on an animal population as shooting them with a gun. Conversely, a landowner who manages land so that certain types of plants and plant communities flourish, or who plants high quality vegetation for animals (food plots), can improve the health, quality, and abundance of local wildlife populations. Supplemental feeding of wildlife is not often economically feasible, so management efforts should concentrate on preventing nutritional problems before they occur. The best way to prevent nutritional problems is to provide high-quality natural foods. This is accomplished by managing the habitat.

There is close relation between availability of food and climate change. Changes in regional precipitation will ultimately affect water availability and may lead to decreased agricultural production and potentially widespread food shortages. Less precipitation during the dry season, this may cause more frequent and severe droughts and increased desertification. It also causes for starvation and mortality of wildlife.

When all other decimating/devastating factors fail to operate sufficiently to keep a population in check, the habitat exerts a final control. This might be either by starvation or malnutrition.

*Starvation*- death caused by lack of food quantity to maintain the metabolic processes of the body. Common among carnivores but rarely occur among herbivores. Under such circumstances, animals are forced to draw on their own bodily reserves for energy, and body structures become weakened to the point where normal functioning cannot continue and the animal dies. Most frequently, before actual starvation takes place, the animal will victim victor to some other decimating factor. Starvation remains as the important contributor for the death of wild animals, although the proximate cause is different.

*Malnutrition*- death due to lack of food quality, is common among herbivores. Malnutrition leads to starvation and death. Starvation and malnutrition usually affect some sex/age classes of animals, especially the very young and very old, more seriously than other sex-age classes



Within any area, large quantities of potential food, water, or cover may be unused because they are too far apart in relation to the customary travels of the animals in an area. An animal could travel a long distance to find water if necessary, but it would do little good if the animal was eaten by a predator along the way. Properly arranging the habitat's components is important to ensure that each component benefits wildlife. Accomplishing this goal requires an understanding of edge, Water requirements of wildlife, in terms of both quantity and quality, vary widely among species. Differences are related to behavioral (e.g., nocturnal lifestyle), morphological (e.g., storage capacity, pelage type, thickness, and color), and physiological (e.g., proportional use of metabolic water) differences. As a result of these differences, some large herbivores can survive extended periods without consuming water (e.g., camel), whereas other species cannot. Moreover, because of these adaptations, required sources of water vary widely among species ranging from free-standing (i.e., streams, lakes, and reservoirs) to that pooled on the surface of plants (i.e., dew), and/or internally incorporated into vegetation (i.e., succulence). The loss of natural water resources threatens wildlife of all sorts.

### **3.4. Diseases**

Disease is defined as any change in the normal function or structure of any part, organ, or system of a living body. It is also defined as a pathological condition occurring in a susceptible population. Diseases often demonstrate characteristic clinical signs, but it may be unclear how disease-causing agents are introduced and transmitted. Pathogens are natural components of ecosystems that may also be limited by environmental conditions or distribution and behavior of their hosts and vectors. Many pathogens are an intrinsic part of biological diversity and ecological complexity of natural, healthy ecosystems. Ecology of wildlife disease (or epidemiology) is the study of interactions between hosts and pathogens as they relate to behavior, biology, the environment, disease transmission, susceptibility, evolution, climate and impacts of diseases on wildlife populations and communities. This discipline works at the interface between ecology and veterinary medicine and thus recognizes importance of a multidisciplinary approach to understand the complexity of disease in wild animals.

Although occurrence of disease in wildlife can be a natural phenomenon or anthropogenic driven, there is an increasing trend toward appearance of novel or introduced diseases with severe consequences for wildlife populations. Chytrid fungus (*Batrachochytrium dendrobatidis*) has impacted amphibian species globally, white-nose syndrome (caused by the fungus *Geomyces*

*destructans*) is threatening cave-roosting bats in North America, diclofenac acid has caused dramatic population declines of Asian vultures, sylvatic plague in black-tailed prairie dog (*Cynomys ludovicianus*) colonies continues to be a major impediment to recovery of blackfooted ferrets (*Mustela nigripes*), and a transmissible cancer is causing declines of Tasmanian devils (*Sarcophilus harrisii*). Disease in wildlife populations is not a natural regulatory process when novel causative agents are introduced into native ecosystems.

Diseases of wildlife can cause significant illness and death to individual animals and can significantly affect wildlife populations. Wildlife species can also serve as natural hosts for certain diseases that affect humans (zoonoses). Zoonoses are diseases transmitted from animals to humans under natural conditions. The disease agents or parasites that cause these zoonotic diseases can be contracted from wildlife directly by bites or contamination, or indirectly through the bite of arthropod vectors such as mosquitoes, ticks, fleas, and mites that have previously fed on an infected animal. These zoonotic diseases are primarily diseases acquired within a specific locality, and secondarily, diseases of occupation and avocation. Global trade, climate change, habitat destruction, and international travel can make conditions ripe for the emergence and spread of diseases between humans and wildlife. Wildlife, domestic animals and humans share a large and increasing number of infectious diseases, known as zoonoses.

Disease can influence reproduction, survival, fitness, and abundance of wildlife populations and can affect biodiversity within ecosystems and present an additional threat to many populations; especially those with limited abundance (i.e. threatened and endangered species). Some pathogens can also be transmitted among conspecifics, other wildlife species, domestic animals, and humans, posing risks to human and animal health and resulting in significant economic impacts. A few examples of important diseases occurring in North American wildlife that may have significant ecological, economic, and health impacts include: chronic wasting disease of North American cervids, rabies and bovine tuberculosis in wild terrestrial mammals, declines of Hawaiian forest birds from introduced avian malaria and pox, and multi-species ecological impacts of avian influenza, West Nile encephalitis, avian cholera, and avian botulism.

### **3.4.1. Impacts of wildlife disease**

#### **i, On Human health**

Zoonotic diseases are diseases of animals that can be transmitted to humans; for example avian influenza, anthrax and rabies. Wildlife plays a key role by providing a 'zoonotic pool' from which new diseases may emerge. The majority (60%) of emerging infectious diseases in humans is caused by zoonotic pathogens and 72% of these have a wildlife origin. Human encroachment on shrinking wildlife habitats can cause increased wildlife population densities which can boost disease transmission risks. Also, increased human population density is linked to a rise in the number of zoonotic infections in humans.

#### **ii, Domestic animal health**

Domestic animal disease can have serious economic effects. Most infectious diseases of domestic animals are common to wildlife, so the control of a disease in domestic animals can be impeded by its presence in wildlife. Movement of domestic animals for trade and farming can help to spread disease. While culling infected livestock can reduce levels of disease, if the disease exists in wildlife it can be passed back to domestic animals at a later point.

#### **iii, Biodiversity**

It is increasingly accepted that diseases can affect biodiversity and contribute to species declines. For example, squirrel poxvirus is contributing to the decline of the red squirrel population, and crayfish plague is considered responsible for declines in native white clawed crayfish numbers.

#### **iv, Animal welfare**

Diseases such as mange in foxes and *myxomatosis* in rabbits can impact on the welfare of wild animals. Disease is a normal process in nature but human interventions can directly cause disease outbreaks in wildlife.

### **3.4.2. Control of wild life disease**

After knowing the transmission, physiology, epidemiology, and ecology of pathogens and how they interact with wildlife hosts is essential for developing effective strategies to prevent or manage disease in wildlife. Preventing introduction of disease into susceptible populations is a paramount responsibility of wildlife professionals as stewards of the resource, and is the most effective method of disease management. Measures designed to prevent disease occurrence including

- Import and transport restrictions,
- Decontamination and sanitation measures and
- Formation of physical or immunological barriers (e.g., fences to separate wildlife from domestic animals, vaccines), have been the tools most commonly used by wildlife managers.
- Avoid competition and crowding to reduce disease transmission
- Infected animals might be culled and removed.
- Intermediate or reservoir hosts may be controlled directly by shooting or poisoning or indirectly by habitat manipulation

### **3.5. Climate Change**

Climate change is already having an impact on the dynamics of world biomes and its rich biodiversity, although species composition and diversity is expected to change due to individual species response to climate change conditions. The rapid rise in temperature combined with other stresses, such as the destruction of habitats from land use change, could easily disrupt the connectedness among species, transforming existing communities, and showing variable movements of species through ecosystems, which could lead to numerous localized extinctions. If some plant species are not able to respond to climate change, the result could be increased vulnerability of ecosystems to natural and anthropogenic disturbance, resulting in species diversity reductions. Climate change is expected to significantly alter the biodiversity as species struggle to adapt to changing conditions.

Historically, climate change has resulted in dramatic shifts in the geographical distributions of species and ecosystems and current rates of migration of species will have to be much higher than rates during post-glacial periods in order for species to adapt. Species that have the capability to keep up with climate shifts may survive; others that cannot respond will likely suffer. For example, biome sensitivity assessments in Africa show that deciduous and semi-deciduous closed canopy forests may be very sensitive to small decreases in the amount of precipitation that plants receive during the growing season, the deciduous forests may be more sensitive than grasslands or savannahs to reduced precipitation. Invasive species and other species with high fertility and dispersal capabilities have been shown to be highly adaptive to variable climatic conditions. Due to its climate sensitive native fauna; East Africa may be particularly vulnerable to exotic and invasive species colonization

The patterns of climates vary from time to time. Rising temperatures and altered precipitation patterns will result in changes in plant communities and reduced habitat suitability for some wildlife species. Some communities and species may shift to higher elevations or latitudes, but this will become ever more challenging as remaining natural areas shrink and the gaps between habitats grow. Climate Change and its impacts may be the dominant direct driver of biodiversity loss and changes in ecosystem services at the global level. The changes of climates having significant impacts on biodiversity and ecosystems, including changes in species distribution, population sizes, food and agricultural security, human health, tourism, the timing of reproduction or migration events, and increases in the frequency of pest and disease outbreaks. Climate change will have significant effects on the health of wildlife, domestic animals, and humans. Climate change will result in increasing average global temperatures; rising sea levels; changing global precipitation patterns. Increasing temperatures, combined with changes in rainfall and humidity, may have significant impacts on wildlife, domestic animal, and human health and diseases.

Climate change is real and happening now. The effects of climate change such as rising temperature and changes in precipitation are undeniably clear with impacts already affecting ecosystems, biodiversity and people. In both developed and developing countries, climate impacts are reverberating through the economy, from threatening water availability to sea-level rise and tourism. In some countries, climate impacts affect the ecosystem services that communities are largely dependent upon, threatening development and economic stability. The effects of climate change such as rising temperature and changes in precipitation are undeniably clear with impacts already affecting ecosystems, biodiversity and people.

### **3.5.1. Temperature increase/decrease**

Evidence that climate change is causing global and regional warming is clear. Regional warming has been associated with changes in physical and biological systems in many parts of the globe. The emission into of CO<sub>2</sub> concentrations in the atmosphere is causes for climate change. This airborne fraction was estimated during the last few decades of the 20th century at about 50%, because the amount of CO<sub>2</sub> buildup in the atmosphere each year (about 3 billion tons of carbon as CO<sub>2</sub>) was about half the fossil fuel injected CO<sub>2</sub>. The Climate change impacts will be

widespread and that a 'business as usual' scenario over the next few decades will result in global mass extinctions on a scale previously unseen in human history.

It may not be possible to avoid impacts of climate change such as the loss of large components of biodiversity including freshwater systems, coral reefs and coastal mangroves. The threat of climate change include the direct impacts on habitat, ecosystem functioning and populations of higher concentrations of carbon dioxide; altered rainfall and temperature patterns; rising sea levels; increased sea temperatures and acidity; and more frequent extreme storms, floods and heat waves. Many species are highly sensitive to changes in climate and weather-related patterns and events. These can disrupt seasonal food supplies and other resources, life cycle events, development, mortality, breeding and fertility, such that entire reproductive strategies become less successful. Expected direct impacts on species populations include:

- Changes in species abundance
- Changes in distribution, and
- Changes in genetics over the long term as species adapt.
- Climate change has the potential to alter migratory routes (and timings) of species that use both seasonal wetlands (e.g., migratory birds) and track seasonal changes in vegetation (e.g., herbivores). This may for instance increase conflicts between people and large mammals such as elephants, particularly in areas where rainfall is low.
- The changing climate is also likely to favour increased the competitiveness of exotic species with native species into new and locally more favourable areas. The ability of species to adapt to changing conditions and recover after extreme climatic events will be compromised by the legacy of fragmentation, habitat loss and other pressures that have collectively reduced overall diversity, population sizes and resilience in many species.

### **3.5.2. Flooding**

Flooding can be caused by elevated water levels in nearby surface water bodies, tidal action, and ground water inflow to the wetland or any combination of these sources. Too much rain in a short period of time causes rivers and streams to overflow onto nearby land in an event called a flood. Natural flood causes for the loss of habitats and food of wildlife. Flooding also may lead into the decline in the water quality by discharging excessive nutrients to the water body. The accumulation of several nutrients in the water body would increase eutrophication. This is also

leads to the reducing the diversity of wild life and suffer mass kills because of a lack of oxygen caused by eutrophication in aquatic ecosystem.

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Floods are very destructive events for people and farm animals. They ruin property and kill animals and people. Plants can usually survive floods. Flash floods have rushing water that destroys everything in its path. These types of floods usually occur in areas of hills or mountains where the water has a chance to run downhill into streams and collect very quickly. Many wild animals have been forced from their natural habitats by flooding, and many domestic animals are also without homes after the flood. Floods not only damage property and endanger the lives of humans and animals, but have other effects as well. Rapid runoff causes soil erosion as well as sediment deposition problems downstream. Spawning grounds for fish and other wildlife habitat are often destroyed. Moreover, it destroys the habitats, food, nutrients of plants, and lives of much wildlife.

### **3.6. Invasive exotic species**

Exotic species are undesirable and dangerous in protected natural areas. There are endless examples of exotic species becoming terrible pests in their new habitats and often out competing and replacing native species as well. Exotic species, those that do not normally live in a country, are introduced for a variety of reasons, and very often they become competitors with the native wildlife. Rabbits in Australia are perhaps the most conspicuous example of this, for they have been implicated in the decline of native herbivores (such as rare yellow-footed rock-wallaby) through either direct competition or apparent competition by supporting exotic predators such as foxes. Exotic species should not be introduced into new habitats unless under exceptional circumstances.

**Exotic** is the adjective most commonly used to describe a species living outside of its native range. *Introduced species*, *non indigenous species*, and *nonnative species* and many botanists refer to *alien* or *adventive* plants. *Invasive species* refers to exotic species that have successfully invaded (or are likely to invade) an ecosystem, causing significant ecological, economic, or human health problems. Most exotic species are not actually invasive. Some people define “invasive” to also include native species that exhibit these characteristics, but most people limit the term to exotics. A species to be exotic if it is outside of its natural geographic range (i.e. the geographic range it would occupy without human interference) regardless of political

boundaries, while most non biologists are likely to call a species exotic if it is from a different nation or state.

However, exotics species are not always harmful because sometimes introduced species are useful for: economic or utilization purposes; establishment of erosion prone areas; biological control of other exotic or pest species; and so on.

During the introduction of exotic species the following points should be considered:

- ☞ Not introduce species which are potential pests, known to feed on domestic stock or crops, known carriers of dangerous diseases, species with high capacity to disperse and reproduce, or close ecological equivalents of local species.
- ☞ Avoid introduction of an exotic species if a local species will do just as well.
- ☞ Take care that the exotic can be controlled or exterminated if necessary.
- ☞ Make trail introductions in small isolated areas where the species can be exterminated if the trails are unsatisfactory.
- ☞ Essential exotics, e.g. Vegetables grown for staff consumption, pack animals for management proposes, should be as few as possible and located outside the protected area or limited to development areas wherever practicable.
- ☞ Avoid introducing any secondary species or diseases with the exotic species.

### **A) Impacts of introducing exotic species**

Alien species can bring to bear one or more of several distinct effects in causing or contributing to extermination/extinction of indigenous plants and animals.

- i. **Predation** - indigenous animals of islands are well known for their tame or fearless behavior that makes them vulnerable to introduced mammalian predators. When such behavior is accompanied by a slow reproductive rate (infrequent breeding and/or clutch size), coexistence with alien predator is difficult.
- ii. **Browsing and grazing** - most alien species have the devastating effect on indigenous species through herbivore especially on islands. If the browsing or grazing continues for any extended period, extinction or near extinction of a plant species would be possible. The indirect effect of browser and grazers, although difficult to measure, is trampling, which can adversely affect plants and animals in variety of ways. The vulnerability of many Island biota's to introduced animals appears to be largely a consequence of the



absence of mammals from most oceanic Islands until the arrival of humans. As a result, island plants commonly lack defensive features effective against the browsing of mammals, and island animals commonly lack behavior effective against predation by mammals.

- iii. **Hybridization** - although recorded cases of loss of an endemic species through hybridization with a closely related species are few, it has occurred sometimes.
- iv. **Food competition** - this is due to overlap in the diet of alien and indigenous species. The competition could be direct and indirect.
- v. **Nest site competition** - competing for available space for nesting, breeding etc.
- vi. **Introduction of disease** - there are many indications that disease introduced by alien animals can contribute to extinction of indigenous species. This effect, however, is even more difficult to investigate than that of predation.

## **B) Control of exotic species**

The presence of exotic or alien species in a protected area is generally contrary to the management objectives of the area. Unless the exotic species has been deliberately introduced to help management or is of such long standing that it is in balance with the ecosystem or of interest in its own right, it is best to attempt to eradicate or control the exotic species. All the methods or management actions suggested to control over abundant wild life populations could also be applied here to control exotic species.

- For removal of exotic animals, hunting and trapping are usually the most effective methods. For instance, poisoning campaigns to eliminate domestic dogs have also been carried out in Ethiopia's Bale Mountains National Park.
- For plants, cutting or ring-barking is often used. Sometimes careful and selective use of herbicides may be necessary. For example, the *Acacia arabica* bushes planted as a fire break around a fire managed grazing area in Baluran National park, Java, are now invading the grazing area and all management attempts to control this encroachment have so far failed. In this case, it may be necessary to use a selective weed killer, even though such poisons should generally not be used in protected areas if there are other alternative methods.

## **UNIT FOUR: MANAGERIAL INTERVENTION**

### **Introduction**

The sorts of management interventions that may be recommended include translocation of individuals to augment target populations, creating larger reserves, raising the carrying capacity by artificial feeding, restricting dispersal by fencing, fostering of young (or cross-fostering of young by related species), reducing mortality by controlling predators or poachers, or through vaccination and, of course, habitat preservation. However, in situations where there are large and healthy wildlife populations, human interventions are often considered ineffective and economically costly, because an equilibrium state will establish itself naturally. For instance, roads are a human impact that may influence animals' ability to move among habitat patches. Whereas part of the impact of a road may be animals avoiding the road itself, due to increased exposure to humans and illegal hunting is likely at greatest effect from roads.

Thus, managerial intervention is good in such and other regards although the limited concern given and the effectiveness continue to be problematic in many areas. Wildlife conservation aims to halt the loss in the earth's biodiversity by taking into consideration ecological principles such as carrying capacity, disturbance and succession and environmental conditions such as physical geography, petrology and hydrology with the aim of balancing the needs of wildlife with the needs of people.

### **Conservation strategies as preservation and development**

Experts of wildlife ecology and management from different parts of the world came together, from 1980-1990, and forwarded five strategic points (World Conservation Strategies- WCS).

- i. Conservation is not just only on wildlife but also concerned with agriculture, fish, habitat and soil (non-living materials)
- ii. Conservation is not only preservation rather maintenance, restoration and sustainable use of natural resources.
- iii. Conservation is essential for development because without conservation development cannot be sustainable. For instance, if you fish all the fish in the area at a time, the fish resource will collapse.
- iv. Development is essential for conservation to be sustainable

- v. Emphasis should be given for strategic action instead of tactical action to make conservation effective. For instance, why soil erosion under gone is strategic action while taking measures to halt soil erosion is tactical.

The aim of the WCS is sustainable development and integrating conservation and development so as to care for the earth. The strategies become principles in 1990 as the principles of sustainable living as listed hereunder.

- a. *Respect and care for the community life*- development should not be at the expense of the people and resources should be shared by all, poor, rich and next generation.
- b. *Improve the quality of human life*- economic development, healthy life, better standard of living, practical freedom
- c. *Conserve the earth's vitality*- important components and diversity. Maintain earth's ecosystem and conserve the biodiversity with sustainable use.
- d. *Minimize depletion of non-renewable resources* such as minerals by switching into alternative resources if possible and use different technology.
- e. *Keep within earth's carrying capacity*-reduce consumption by stabilizing population
- f. *Change personal attitude and practices*- motivate and educate the people to live sustainable life by minimizing wastage.
- g. *Enable communities to care for their own environment* irrespective of property (poor and rich), urban and rural. Offer them the right to participate in environmental issue and make decision by themselves.
- h. *Provide a national/governmental frame work* for integrating development and conservation-establishment of institutes (such as World Resources Institute-WRI), environmental law, well developed plan for monitoring and carrying out research and to give benefits for community.
- i. *Establish/form a global alliance/association* among countries-poor countries should be helped by richest nations for sustainable development and international laws and conventions (Convention on International Trade in Endangered Species-CITES) should be formulated.
- j. *Develop national energy strategies*- for instance commercial energy sources such as oil, gas are bad and create pollution thus identify and use alternative energy sources.
- k. *Develop business and industries*- especially low income countries should develop industry to overcome poverty by shifting from ordinary agriculture to industrial agriculture.

- l. *Human settlement should be improved*- basic infrastructure should be fulfilled and cities should be clean, clear, and green.
- m. *Conserve farm and range lands*- make these areas sustainable by using fertilizers, but reduce pesticides to minimize pollution.
- n. *Conserve forest and wood lands*- manage it by planting for the used ones
- o. *Maintain freshwater, ocean and coastal areas* properly by reducing pollution.

#### 4.1. Solving problems

Problems can be defined broadly as situations in which we experience uncertainty or difficulty in achieving what we want to achieve. It is very important to understand the nature of a problem prior to looking for the best solution. Problem solving requires two distinct types of mental skill, analytical and creative. Before you start trying to solve a problem you need to be sure that a problem exists, discover precisely what it is, and decide whether it is important enough to warrant time and effort in solving it. Whenever we encountered problems we need to recognize problems efficiently; define problems effectively; decide if action is necessary and when in wildlife management.

Some of the problems in wildlife might be:

- ☞ *Large scale modification* of the environment in many parts of Europe due to agricultural development and urbanization has greatly reduced the availability of appropriate site for wildlife.
- ☞ *Man made barriers* such as high tension cables are one of the major threat to large migrant birds
- ☞ In Africa Savanna's have been turned in to deserts and semi-deserts by man. This is due to *excessive use of soil and vegetation, over cultivation and overgrazing*. When rainfall is reduced or is none existent, it may be very hard for birds to find sufficient food. If they fail to accumulate extra fat shortly before departing northward, they may be unable to migrate and be obliged to pass summer in Africa.
- ☞ *Pesticides* have been used increasingly in African agriculture. Migrant birds directly ingest and also indirectly affected, because populations of their food source (insects) have been reduced using insecticides. Pesticides not only affect migratory birds but are ultimately dangerous to the other animals and human environment.
- ☞ *Wet land destruction*- the wet lands of Europe and Africa support huge concentrations of migratory birds. Many of the lakes and marshes are being drained to create more

agricultural land and water is being taken from such wet lands to irrigate dry land and generate electricity. Wet lands often support local fisheries and livestock, so their conservation can be of value to mankind as well as migratory birds.

☞ *Illegal hunting/Poaching*- for instance, indiscriminate illegal persecution of migratory birds in the Mediterranean area. Where some 50 years ago the harvesting of birds was carried out as a necessary additional source of protein, but nowadays birds are mainly killed for pleasure.

Hence wildlife manager should intervene on the existing situations of the wildlife conservation if there is any unsustainable act, by preferring strategies systematically based on their labor cost, side effects, financial affairs, and time. Problem solving is the basic pillar in wildlife management. The problems of conservation are complex; partly because of inadequate knowledge of the ecosystem relationships; partly because of conflicts between groups with different interests.

Growing pressures from increasing human populations and the consequent greater need for agricultural land tend to reduce the areas of land available for wildlife. Once a given area is taken over for agricultural and pastoral practices, its wildlife will be largely exterminated and its natural vegetation disturbed, if not completely destroyed. Since the area of land which can be set aside for nature reserves is limited, ecological influences on animal populations and their distribution are distorted. Natural fluctuations in animal numbers cannot be absorbed in a limited habitat.

The danger of destruction of the habitat by population explosions within the reserves (often a result of the imbalance produced by restraining man from his traditional hunting activities) cannot be prevented by the overspill or dispersion of the surplus population into the neighbouring areas, which would occur in a completely natural state. The human need for farm activities, which are pressing ever more closely upon the borders of reserved areas, takes priority over the needs for unlimited space of uncontrolled game herds, and domestic herds need to be kept within tolerable limits. The recommend steps for *systematic conservation planning* include the following:-

- a. Compile data on biodiversity and on the distribution of rare and endangered species in the planning region

- b. Identify conservation goals and set explicit conservation targets for species and community types as well as quantitative targets for minimum reserve size and connectivity
- c. Review existing conservation areas to measure the extent to which quantitative goals have already been achieved and identify imminent threats to underrepresented species and community types
- d. Select additional conservation areas to supplement existing reserves in a way that best achieves the conservation goals
- e. Implement conservation actions having decided the most appropriate form of management for each area and having established an implementation timetable if resources are not available for all actions to be carried out at once
- f. Maintain the required values of conservation areas and monitor key indicators that will reflect management success, modifying management as required

There is a general agreement now that, on moral, aesthetic and scientific grounds, no animal species should be allowed to become extinct. National parks and reserves of various sorts exist in many countries, partly to accomplish this museum goal of the preservation of at least a viable nucleus of every species in a natural habitat. In the developing countries pressures are particularly great to make use of wild tracts of land for agricultural purposes. Wildlife conservation is also important to the economy through the fur trade, tourism and leisure (hunting & fishing).

#### **4.2. Development of wildlife facilities**

Modern humankind, using the advanced technology of an industrial society, has had neither the time nor the desire to adapt to the ecosystem as anything except a destructive force. Much use has been made of fire, water and land development in ways which have often devastated local habitats and food cycles of wildlife. These facilities include habitat with required quantity and quality of food, water, shelter/cover, breeding site and nesting site. For instance, to maintain productive wild life populations for harvesting stock health or otherwise enjoying (recreation), management must maintain habitat that fulfills the food requirements of both sexes and all age classes of animals throughout the year.

Four procedures for supplying foods in wild life habitat may be used. The first two procedures can be used in extensive management. As management becomes more intensive, there should be more emphasis on the third and fourth procedures.

- i. *Provide vegetation type and successional stages to which the species has adapted via evolution.* For example, Swayne's hartebeests are adapted to grass successional stages within the Acacia woodland forest. Therefore, management must provide periodic disturbance, such as logging, burning to maintain this stage of forest succession.
- ii. *Provide a variety of vegetation types.* Since food requirements vary within wild life species, and food supplies vary seasonally and among vegetation types, the probability of having an important food deficiency declines as variety increases in the habitat. Any deficiency in one vegetation type may be alleviated in another vegetation type.
- iii. *Provide foods known to be preferred and of high quality.*
- iv. *Watch for symptoms of deficiencies and manipulate the deficiencies.*

As management becomes more intensive, animals may be observed or forage may be measured in a systematic way to evaluate food adequacy at a critical season or for one age class of the population.

### **4.3. Safaris**

The word safari originates from the Kiswahili (Swahili) language. The meaning of the word 'safari' is a long journey and has become the international description of a trip into the wild. It has now become the accepted term to describe wildlife viewing or game drives in the national parks and reserves of Africa. A safari, especially in Africa is defined as an overland journey or cross country expedition for observing wild animals. Safari is a distinctive way of hunting. It may consist of several days or even weeks-long journey, with camping in the bush or jungle, while following big game. Nowadays, it's often used to describe tours through African national parks to watch or hunt wildlife. Hunters are usually tourists, accompanied by licensed and highly regulated professional hunters, local guides, skimmers, and porters in more difficult terrains. A special safari type is the solo-safari, where all the license acquiring, stalking, preparation, and outfitting is done by the hunter himself. This licensed and professional hunting is important to regulate population size or trigger populations to increase. Photo-safaris were popular even before the advent of ecotourism. The synonym "bloodless hunt" for hunting with the use of film and a still photographic camera was first used by the Polish photographer.

Thus, in 1933 American biologist Aldo Leopold developed a theory that each unit of habitat can support only so many animals of a given species, and that excess animals must be cropped by hunters or allowed to die. Since that time, game laws have been designed so that hunters crop the annual surplus of game animals without threatening actual game populations. Such regulations, which make hunting a crucial part of game management, have allowed wildlife to thrive in the United States. Other nations, notably those in Africa, have also followed this principle, but however illegal poaching for food or trophies remains a problem.

#### **4.4. Lodges**

Lodge, in general, is a place or small house located in a park, forest, or area; a hut or cottage, often rural, used as a temporary abode or shelter/habitation. It is also the den of certain animals, such as the dome-shaped structure built by beavers. In general, it is a place offering inexpensive overnight accommodation with basic amenities/public facilities or pleasantness. The lodge was often the cottage of the gamekeeper, caretaker, gatekeeper, or gardener, or it could be a larger building for occupation by a higher-ranking person.

Although lodges originally used as an insubstantial dwelling for a temporary occupational purpose (e.g. woodcutting or masonry) or for use during the hunting season; the lodge is now used as a more permanent type of house established in parks. Today the word suggests a rustic dwelling or public house in a natural setting, often one used seasonally (e.g., a ski lodge). Lodges can be park lodge, hunting lodge or ski lodge although the intention is to enjoy with natural setting.

**Park Lodge-** Park Lodge has for the most part of its history been just the building with bedrooms and communal accommodation. This building is staffed on a 24- hour basis and offers more intensive staff support and supervision to the most needy and vulnerable service users. In so doing wildlife can be protected for the sake of recreation in the park.

**Hunting lodge-**at the Hunting Lodge you will receive the special touches and personal service that only a privately owned hotel can offer. In here people enjoyed by hunting different animals found either in nature reserve or protected areas.

Thus lodges can be constructed in national parks or nature reserves to secure the basic amenities for these people visiting the area as well as for better managements of wildlife in general and to rescue some endangered species of animals in particular.



#### 4.5. Sport hunting

Species that are hunted or harvested by people have historically been at grave risk of extinction. Overharvesting of natural populations can rapidly reduce the population size of a species, even when that species is initially very abundant. A century ago the skies of North America were darkened by huge flocks of passenger pigeons; hunted as free and tasty food, they were driven to extinction. The buffalo that used to migrate in enormous herds across the central plains of North America only narrowly escaped the same fate, a few individuals preserved from this catastrophic exercise in overhunting founding today's modest herds.

The existence of a commercial market often leads to overexploitation of a species. The international trade in furs, for example, has severely reduced the numbers of chinchilla (rodent), vicuna, otter, and many wild cat species. Generally, a variety of factors can make a species particularly vulnerable to extinction. However, population regulation is also recommended by managerial intervention using sport hunting as a tool. Hunting can be subsistence, commercial, and sport hunting although all involve the chase and killing of wild animals.

- ✓ **Subsistence Hunting-** Subsistence hunters hunt animals for food, skins and bone, and at some time in the history of all nations it was an essential way of obtaining food. Today, subsistence hunting is very important all over Africa. In Botswana, bush meat (e.g. spring hares, small antelopes, and birds) is an important source of protein for many people. However, the stress that hunting inflicts on animals; the noise, the fear, and the constant chase, severely restricts their ability to eat adequately and store the fat and energy they need to survive the winter. Hunting also disrupts migration and hibernation, and the campfires, recreational vehicles, trash, and other hunting side effects endanger both wildlife and their habitat.
- ✓ **Commercial Hunting-** where legally carried out, involves the killing and sale of animals' surplus to the carrying capacity of a region. The purpose of commercial hunting or hunting for food is simply to harvest a product such as meat and skins. There is an ethical aspect, however, that is fundamental to wildlife harvesting: the operation, be it for recreation or profit, must result in a sustainable off take, a yield that can be taken year after year without jeopardizing/endangering future yields. The commercial value of game birds and mammals has encouraged many farmers to run wild animals together with domestic stock. This has resulted in an increase in numbers of many species, for example

springbok, impala, and blesbok (antelope) in South Africa, and the saiga antelope in Russia.

- ✓ **Illegal commercial hunters** (or commercial poachers) break the law to hunt animals for sale. This is highlighted in Africa by the illegal hunting of elephants for their ivory, and rhinos for their horns. No regard is given to the future of the species, their future economic, potential or to sport. This form of hunting is opposed by both the public and government agencies. In some places wildlife managers do something to safeguard the animals. For instance, in South Africa, in order to minimize poaching of rhinos for their horns wildlife managers usually capture the animals and dehorn them although it is a costly activity. Even dehorning by itself has disadvantages in that horns re-grow back, poachers kill dehorned animals without benefit and horn is ecologically important as a defensive organ from enemies.
- ✓ **Sport Hunting-** Sport hunting, where animals are not hunted for food or profit, but for the enjoyment of the hunter, and are a subject of increasing criticism. To many, it is unacceptable that people should enjoy just by killing of animals. Those opposed to sport hunting believe that we have no right to kill animals simply for our own enjoyment. Sport hunting often revolves around the acquisition of a trophy. On the other hand, the sport hunter of today does not regard the act of killing as being the object of his sport. If it were so, he could simply buy and kill domestic animals such as sheep or chickens. To the sport hunter, hunting involves the challenge of outsmarting the prey/source in the wild. It means learning the behaviour of the animal, the habitats it prefers, the tracks and signs which indicate its presence. It requires an ability to follow prey, and skill in the use of one's weapon, be it rifle, shotgun or bow and arrow. To hunt means to be outdoors, the more un-spoilt and natural the country and the more challenging the quarry, the greater the degree of enjoyment. In nature, individual animals, usually the weak and diseased or old are killed by predators. This enhances the productivity and vigour of the population.

### **Sport Hunting for Habitat and Species Conservation**

The sport hunters are expected to pay large amounts of money for their activity. In so doing they give an incentive to the landowner to maintain the natural habitats which are home for the hunted animals. Thus large areas of land, incorporating a variety of habitats, plants and animals are

conserved because the sport hunters pay the landowner to do so. If the landowner was not earning money from hunters, he would have to farm his land conventionally, with crops or domesticated livestock, usually at the expense of wildlife.

**The maximum sustained yield** - is harvesting a population at maximum sustained yield. Harvesting a population at the maximum sustained yield should never be practiced. It imparts instability to the population's dynamics. The maximum sustained yield can be taken only from the unique maximum sustained yield density. If the population density has, for environmental reasons (such as drought, predation etc), dropped below that value then the maximum sustained yield represents an overharvest and the population's density is reduced further. Continued harvesting of the maximum sustained yield will make the problem worse and even lead to extinction. Therefore, if a population increases by 50%, it is advisable to take ~ 40% and the like. In the face of the ever expanding human population and its demands on resources, all resources must earn money. One way of making natural, conserved areas pay, and thus assure a future for wild animals and habitats, is to promote well managed sport hunting.

As times change, so do the needs of humans and animals. The evolution of species and introduction of new technology keep us on our toes and often influence the way we go about our daily lives. Hunting has not been untouched by the changes brought about with time. As hunting is no longer a necessary means for survival, its presence in our society is under scrutiny. While some want to maintain the time-honored tradition, others want to see a pastime they feel is unfair restricted by law. Hunting has evolved into a sport and gained a fan base and an opposition. Those who enjoy the sport can find its positive attributes, but anti-hunting organizations see it as cruel treatment of animals.

#### **4.6. Wildlife conservation areas**

Before going into the details of national park, sanctuary and reserves let us understand what conservation is. Conservation is the wise, proper, rational and sustainable use of natural resources endowed in nature. Wildlife is a national asset and part of the heritage of all mankind. The wildlife of today is not ours to dispose of as we please. We have it in trust and must account for it to those who come after. Therefore, by conservation activity there is use of resources sustainably, that is, use it but do not destroy it or do not take out in excess. Among the greatest challenges facing the biosphere today is the accelerating pace of species extinctions. Biological

diversity throughout the world is being threatened by human activity: species are being driven to the edge of extinction; and biological communities are being degraded, fragmented, and destroyed; and the genetic variation within species is being lost as populations are reduced in size and lost.

Conservation of biodiversity is an urgent matter of common concern and should be an integral part of the development process, as outlined in the Convention on Biological Diversity. The conservation of species at risk often involves establishing protected areas and sometimes the translocation of individuals to new locations. Both approaches should be based on considerations of the niche requirements of the species concerned. The most important method to protect biological diversity is to establish national parks, sanctuaries, nature reserves, and other protected areas. Such efforts to protect biological diversity in their natural habitats are referred to as *in situ* or on-site conservation.

Approximately 6 percent of the world's land surface is designated as protected areas, with more national parks being designated each year. Many new marine reserves are being established to protect the nursery grounds for commercial fish species and maintain high-quality areas for recreation and tourism. Hence, natural resources are conserved for their biological, economic, and recreational values, as well as their natural beauty and importance to local cultures. For example, tropical rain forests are protected for their important role in both global ecology and the economic livelihood of the local culture.

The roots of conservation are lost in prehistory. No doubt there was a time when human reason, growing ever more sophisticated through the millennia, began to extend the idea of deferred gratification ("save this fruit to eat tomorrow rather than now") over much longer periods. "Leave these tubers so there will be more next year when we pass this place." "Take this calf home so that we can raise it and eat it next winter when it is bigger and we have little food." The roots of preservation are probably quite ancient too. Sometimes, large areas such as sacred mountains were decreed off-limits or visited only on religious occasions. Conservation was an issue during the period when European states were colonizing the rest of the world, because colonization often led to disruption of traditional systems of natural resource use and rapid overexploitation, despite the protestations of some sensitive, farsighted people who argued for

moderation. This was particularly true on some small, tropical islands such as Mauritius and Tobago, where the consequences of overexploitation became apparent very quickly.

Conservation started in North America by European immigrants many years ago. It started in 1872 as a big mass movement due to pollution and population growth and established Yellow Stone National park by the same year, next in Australia (1886), Canada (1889) and New Zealand (1898). In Africa, the first national park was established in 1925 when Albert I of Belgium designated an area of what is now Democratic Republic of Congo centered around the Virunga Mountains as the Albert National Park (renamed Virunga National Park). In 1926, the government of South Africa designated Kruger National Park as the nation's first national park. The intension of preserving protected area was to protect scenery and public hunting and fishing were possible in protected areas until 1950. But later wildlife conservation becomes the primary concern and scenery become second.

### **A) What is conservation area?**

A conservation area is a tract of land that has been awarded protected status in order to ensure that natural features, cultural heritage or biota are safeguarded. Conservation areas are ecological area where wildlife is conserved by maintaining habitats, natural resources and preventing poaching. A conservation area may be a nature reserve, a park, a land reclamation project, or other biosphere reserves. Conservation areas could have the following uses: aesthetic value, ecological value, for education/research, preservation of genetic diversity, local employment, for protecting wildlife as natural heritage and they have a right to live, etc.

Taking the definitions of protected areas by IUCN and the Convention on Biological Diversity (CBD), one can delineate the following key features of a conservation area:

- ☞ geographical limits or boundaries;
- ☞ predominantly aimed at achieving conservation benefits, but not excluding other related benefits;
- ☞ designation and management by legal or other effective means;
- ☞ existence of a body of governing rules; and
- ☞ a clearly identified organization or individual with governance authority.

Dispute over whether protected areas, such as national parks, or community conservation areas are best for conservation is probably unnecessary because both have their advantages and disadvantages as given below:

**i, Advantages of community conservation areas**

- Can represent species not included in protected areas, for example non-charismatic species (lower animals, microbes, fungi), and
- Can co-opt/invite support of local peoples if benefits accrue/add to them.

**ii, Disadvantages of community conservation areas**

- Tend to protect only species of direct benefit to humans, and ignore the rest, which is the vast majority,
- Excludes species those are detrimental to humans, and
- Tend to discount the future due to
  - ✓ increasing human population demands on the ecosystem and
  - ✓ accelerating economic expectations from the system even with stationary human populations.
  - ✓ These results in species loss and ecosystem decline.

**I, Advantages of protected areas**

- Will protect fragile habitats (swamps, tundra, islands, and endangered species),
- Will protect large species that cannot coexist with humans, for example large carnivores and herbivores, and
- Can act as ecological baselines or benchmarks to monitor human disturbance outside.

**II, Disadvantages of protected areas**

- They do not represent all ecosystems or communities, often being selected for other reasons,
- They are often too small to maintain viable populations, particularly of species that are adapted to live in large groups or that migrate across international borders (e.g. migrating antelopes, shorebirds), and
- Can alienate/isolate local indigenous peoples excluded by central governments.

Despite some shortcomings, we can generally expect to conserve the greatest biodiversity if we protect whole communities by setting aside protected areas. Protected areas of various kinds (national parks, nature reserves, multiple-use management areas, etc.) grew in number and area

through the 20<sup>th</sup> C, with the greatest expansion occurring since 1970. However, the 4500 protected areas in existence in 1989 still only represented 3.2% of the world's land area. At best, and given the political will, perhaps 6% of land area may eventually be provided protection – the rest would be considered necessary to provide the natural resources needed by the human population. Understandably, but nevertheless disturbingly, reserves have often been established on land that no one else wants.

Areas of high species richness and distributions of endangered plant and animal species often overlap with human population centers. Thus, although protection of wilderness is of value and relatively easy, conserving maximum diversity will require greater focus on areas of high human value. Priorities for marine conservation, which have lagged behind terrestrial efforts, are now being urgently addressed. In taxonomic terms, most of the world's biota is found in the sea (32 of the 33 known animal phyla are marine, 15 exclusively so) and marine communities are subject to a number of potentially adverse influences, including overfishing, habitat disruption and pollution from land-based activities. The overall aim of conservation areas, whether terrestrial or marine, is to represent the biota of each region in a way that separates the biodiversity from the processes that threaten it.

#### **4.6.1. National parks**

A national park is a reserve of natural, semi-natural, or developed land that a sovereign state declares or owns. National parks are areas which are strictly reserved for the betterment of the wildlife. They are generally understood to be administered and maintained by national governments hence the name and reserved for the improvement of wildlife. Although individual nations designate their own national parks differently, an international organization, the International Union for Conservation of Nature and Natural Resources (IUCN), and its World Commission on Protected Areas, has defined National Parks as its category II type of protected areas. While ideas for this type of national park had been suggested previously, the United States established the first National Park, in 1872. The largest national park in the world meeting the IUCN definition is the Northeast Greenland National Park, which was established in 1974. According to the IUCN, there were 6,555 national parks worldwide in 2006 that meet its criteria.

In 1969 the IUCN declared a national park to be a relatively large area with particular defining characteristics. A national park was deemed to be a place:



- ✦ With one or several ecosystems not materially altered by human exploitation and occupation, where plant and animal species, geomorphological sites and habitats are of special scientific, educative and recreational interest or which contain a natural landscape of great beauty.
- ✦ The highest competent authority of the country has taken steps to prevent or eliminate exploitation or occupation as soon as possible in the whole area and to effectively enforce the respect of ecological, geomorphological, or aesthetic features which have led to its establishment.
- ✦ Visitors are allowed to enter, under special conditions, for inspirational, educative, cultural, and recreational purposes.

In 1971 these criteria were further expanded upon leading to more clear and defined benchmarks to evaluate a national park. These include: a minimum size of 1,000 hectares within zones in which protection of nature takes precedence/preference; statutory/constitutional legal protection; a budget and staff sufficient to provide sufficient effective protection; and prohibition of exploitation of natural resources (including the development of dams) qualified by such activities as sport, fishing, the need for management, facilities, etc.

Conservation areas which may include terrestrial land or land covered by lake, or other wetlands set aside for the purpose of conserving and protecting wildlife and objectives of aesthetic, ecological and scientific interest. Activities prohibited in the national parks include the following: hunting, cultivation, grazing livestock, forestry operation/felling trees, burning vegetation/habitat manipulation residing in, or exploiting natural resources in any manner, unless these activities are for the development and management of the park, etc.

National parks, in most part of the world, occupy very small part of many countries. Wildlife in most areas within the region faces major threats from the loss of natural habitats for agriculture, forestry, or human settlement. These natural habitats, and the wildlife that need them, will have to compete on economic terms with other forms of land use if they are to survive. Over the last 100 years national parks have been established for achieving the expected objectives and their management has been modified several times. The objectives are not mutually exclusive; tend to be added rather than replacing the previous ones and are given below:

- a. To conserve scenery and “nice” animals. The aim translated into restricting roads and railways and attempting to exterminate the carnivores. Banff National Park, Canada, has such a history.
- b. The conservation of soil and plants. This aim was a direct consequence of the rise of the discipline of range management in the USA during the 1930s. Its axiom was (and still is) that there is a “proper” plant composition and density. Enough herbivores were to be shot each year to hold the pressure of grazing and browsing at the “correct” level.
- c. The conservation of the physical and biological state of the park at some arbitrary date. In the USA, South Africa, and Australia that date marked the arrival of the first European to stand on the land. This is the source of much of the controversy in Yellowstone National Park, USA (world’s first National park established in 1872).
- d. The fashion shifted to the conservation of representative examples of plant and animal associations. The wording is from Bell’s (1981) definition of the function of national parks in Malawi, but the objective underlies the management of many national parks in many other countries.
- e. The conservation of “biological diversity” (or biodiversity). This catch phrase had two meanings. It was sometimes used in the sense of “species diversity” whereby the information-theory statistic of Shannon and Wiener could be used to estimate the probability that the next animal you saw would differ at the species level from the last. Within park management the idea translated as “the more species the better.” The second meaning dealt with associations rather than species: the more diverse a set of plant associations the better the national park.
- f. The conservation of “genetic variability.” The phrase can be defined tightly and usefully, but within the theory and practice of park management it lacked focus. It was tossed around with little or no attempt to define or understand what it means, whether the variability sought was in heterozygosity, in allelic frequency, or in phenotypic polymorphism. In practice it again translated into “the more species the better.”
- g. The most recent objective differs in kind from the six previous objectives. “The purpose of a nature reserve [in which category they include national parks] is to maintain, hopefully in perpetuity, a highly complex set of ecological, genetic, behavioral, evolutionary and physical processes and the coevolved, compatible populations which participate in these processes.” “The resource is wildness.”

#### **4.6.2. Sanctuaries**

Sanctuaries are set aside to conserve characteristic wildlife communities or to protect a particularly threatened species or habitat. They are tracts of land where wild animals can take refuge without being hunted. It is any place of safety. An animal sanctuary is a facility where animals are brought to live and be protected for the rest of their lives. Unlike animal shelters, sanctuaries do not seek to place animals with individuals or groups, instead maintaining each animal until its natural death. In some cases, an establishment may have characteristics of both a sanctuary and a shelter; for instance, some animals may be in residence temporarily until a good home is found and others may be permanent residents. The mission of sanctuaries is generally to be safe havens, where the animals receive the best care that the sanctuaries can provide.

Animals are not bought, sold, or traded, nor are they used for animal testing. The resident animals are given the opportunity to behave as naturally as possible in a protective environment. What distinguishes a sanctuary from other institutions is the philosophy that the residents come first. In a sanctuary, every action is scrutinized for any trace of human benefit at the expense of non-human residents. Sanctuaries act on behalf of the animals, and the caregivers work under the notion that all animals in the sanctuary, human and non-human, are of equal importance.

A sanctuary is not open to the public in the sense of a zoo; that is, the public is not allowed for unrestricted access to any part of the facility. A sanctuary tries not to allow any activity that would place the animals in an unduly stressful situation. Prohibited activities in sanctuaries include grazing of cattle, settling, and hunting of animals, unless acting in accordance with the conditions of a permit, or written permission of the general manager or a game warden. Private ownership rights are permitted as long as they do not interfere with the well being of the animals. Accordingly, activities like collection of forest products, harvesting of timber, private ownership of land and tilling of land are allowed. One of the most important missions of sanctuaries, beyond caring for the animals, is educating the public. The ultimate goal of a sanctuary should be to change the way that humans think of, and treat, non-human animals. Babillie (elephant), Kuni-muktar (Mt. nyala), Senkelle (Swayne's hartebeest) and Yabello (zebra) are examples of sanctuaries in Ethiopia.

#### **4.6.3. Reserve areas**

A nature reserve (natural reserve, preserve) is a protected area of importance for wildlife, flora, fauna or features of geological or other special interest, which is reserved and managed for

conservation and to provide special opportunities for study or research. Nature reserves may be designated by government institutions in some countries, or by private landowners, such as charities and research institutions, regardless of nationality. Nature reserves fall into different IUCN categories depending on the level of protection afforded by local laws.

Wildlife reserves or game reserve areas are set aside for protecting and propagating wildlife and its habitat; however it is not as exclusive as a national park. Persons are prohibited from residing in game reserves without written permission from the authority or public affairs on duty and persons who were resident before the date of declaration. Persons authorized to reside in game reserves have the right to cultivate their land and to pasture and water domestic animals therein. Prohibited activities include possession of firearms and hunting of animals.

Game reserves are multipurpose protected areas which are intended for preventing genetic diversities in representative ecosystems by protecting wild populations, traditional life styles of tribal and domesticated plant/animal genetic resources. In biosphere reserve, multiple land use is permitted by designing various zones. Such as:

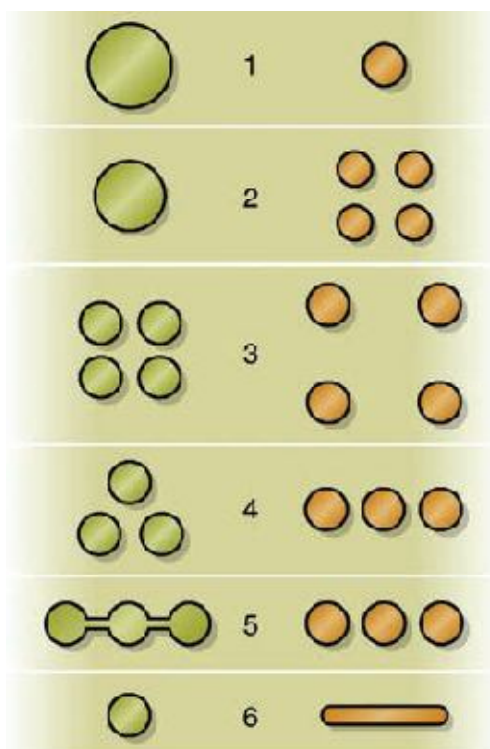
- a. **Core zone**- no human activity is allowed, people are prohibited from residing in such area except public officers on duty.
- b. **Buffer zone**- limited human activity is permitted and people who were resident before date of declaration are permitted to reside; i.e. original settlers are there but new comers do not allowed living there.
- c. **Manipulation zone**- human activity is allowed but ecology is not allowed to be disturbed
- d. **Restoration zone**- degraded area for restoration to near natural form

#### 4.6.3.1. Reserve design

Reserve selection is inevitably followed by reserve design: deciding how large the reserve should be, where its boundaries should lie, and other issues. There are six features proposed in designing a nature reserve area which determined based on size, shape and location (fig 5).

- a. **Size**- A large reserve will hold more species than a small reserve because of species-area relationships. The first requirement is for the reserve to be large enough to hold a viable population of the species it is trying to conserve; the same principle apply as for breeding of captive population. Thus, large reserve is preferable than small reserve.

- b. *Shape*- By making reserves as circular as possible, dispersal within the reserve will be enhanced, and the negative effects of edges will be minimized. If the shape is not predetermined (to include natural features such as river bank, mountain top, or lake) then, in most cases the best shape is circular. Circular reserves are better than rectangular reserves even if they have equal area. This is because the circular reserves have smallest amount of edge effect/bad areas possible for a given area. Thus edge effects should be minimized by making the reserve as circular as possible.
- c. *Number of reserves*- A single large reserve is preferable to several small reserves of equal total area, assuming they all represent the same ecosystem type. It is better to have one large reserve rather than several small reserves although the sum area of smaller ones equal to the single larger one as large reserves are more likely to have many available habitats than smaller ones. However, small several reserves may be better than one large one because they cover wide range of environmental conditions and may be beneficial in other ways catastrophes like fire, flood, disease or hurricanes are unlikely to damage all the sites at the same time. The drawback of small several reserves is that the edge effect will be more influential and they may too small to maintain adequate population of some species.
- d. *Cluster/linear reserve*- Arranging small reserves in a cluster, as opposed to a linear fashion, will also facilitate movement among the reserves. Cluster reserves are better than linear reserves to minimize edge effect
- e. *Linked/unlinked reserves*- Connecting the reserves with corridors will make dispersal easier for many species. Linked reserves are preferable than isolated/unlinked reserves. This is because the link/corridor gives the organisms to move from one habitat to another habitat types.
- f. *Close/distal reserves*- If it is necessary to have multiple small reserves, they should be close to one another to minimize isolation. Closer reserves are better than distant reserves.



**Figure 5.** Schematic representations of design principles for nature reserves. In each pair the design on the left will probably have a lower extinction rate and thus may have higher species diversity.

#### Activity 4.6

Why single large reserve area is preferred than several small reserves?

#### 4.6.3.2. Effects of Corridors

Corridors are areas of continuous habitat that permit animals to travel securely from one habitat to another. As environments become more broken up (fragmented) from construction or roads, parking lots, urban areas, harvest of timber, clearing for agriculture, etc., small islands of vegetation remain. Corridors allow animals to find and use the islands of suitable habitat. For example, in an urban area, relatively unbroken corridors found along riparian areas and ravines allow wildlife to move into parks, and other suitable habitats. Preservation, maintenance, and creation of un-broken corridors are very important in wildlife habitat management. Corridors between reserves provide the benefit of increasing the size of populations and thereby decreasing the chance of demographic malfunction.

However, the overall benefit of corridors is not at all clear cut and must be decided upon case by case. The use of corridors might be influenced by the following factors:

- a. The biology, ecology, and life history of the species.

- b. Habitat suitability, including the degree of original vegetation integrity, length, and width.
- c. Location of corridors in the landscape.
- d. The type of disturbance in the matrix surrounding fragments and corridors.
- e. Suitability of the matrix habitat.

#### **A) Potential advantages of corridors**

1. Increased immigration rate to a reserve, which could:
  - i. increase or maintain species richness (as predicted by island biogeography theory);
  - ii. increase population sizes of particular species and decrease probability of extinction (provide a “rescue effect”) or permit re-establishment of extinct local populations;
  - iii. prevent inbreeding depression and maintain genetic variation within populations.
2. Provide increased foraging area for wide-ranging species.
3. Provide predator-escape cover for movements between patches.
4. Provide a mix of habitats and successional stages accessible to species that require a variety of habitats for different activities or stages of their life cycles.
5. Provide alternative refugia from large disturbances (a “fire escape”).
6. Provide “greenbelts” to limit urban sprawl, abate pollution, provide recreational opportunities, and enhance scenery and land values.

#### **B) Potential disadvantages of corridors**

1. Increased immigration rate to a reserve which could:
    - i. facilitate the spread of endemic diseases, insect pests, exotic species, weeds, and other undesirable species into reserves and across the landscape;
    - ii. decrease the level of genetic variation among populations or subpopulations, or disrupt local adaptations and co-adapted gene complexes (“outbreeding depression”)
  2. Facilitate spread of fire and other abiotic disturbances (“contagious catastrophes”)
  3. Increase exposure of wildlife to hunters, poachers, and other predators.
  4. Riparian strips, often recommended as corridor sites, might not enhance dispersal or survival of upland species
  5. Cost, and conflict with conventional land preservation strategy to preserve endangered species habitat (when inherent quality of corridor habitat is low)
- .



## **4.7. Approaches and methods of habitat conservation**

Determining the size, type and location of habitat to conserve is a complex area of conservation biology. Although difficult to measure and predict, the conservation value of a habitat is often a reflection of the quality (e.g. species abundance and diversity), endangerment of encompassing ecosystems, and spatial distribution of that habitat.

### **a) Identifying priority habitats for conservation**

Habitat conservation is vital for protecting species and ecological processes. It is important to conserve and protect the space/ area in which that species occupies. Therefore, areas classified as ‘biodiversity hotspots’, or those in which a flagship, umbrella, or endangered species inhabits are often the habitats that are given precedence over others. Species that possess an elevated risk of extinction are given the highest priority and as a result of conserving their habitat, other species in that community are protected thus serving as an element of gap analysis.

### **b) Determining the size of the habitat (how much habitat is enough)**

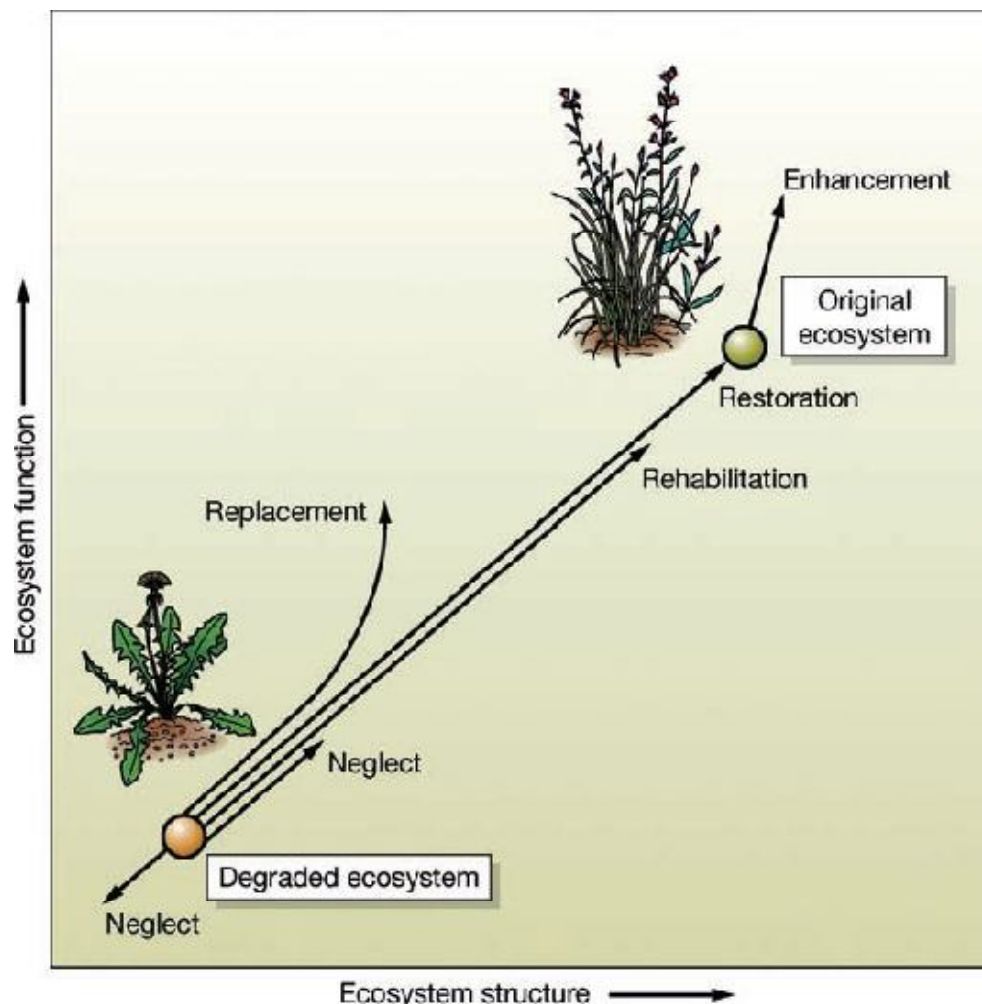
A range of methods and models currently exist that can be used to determine how much habitat is to be conserved in order to sustain a viable population. Modelling tools often rely on the spatial scale of the area as an indicator of conservation value. There has been an increase in emphasis on conserving few large areas of habitat as opposed to many small areas. This idea is often referred to as the “single large or several small”, SLOSS debate, and is a highly controversial area among conservation biologists and ecologists. The reasons behind the argument that “larger is better” include the reduction in the negative impacts of patch edge effects, the general idea that species richness increases with habitat area and the ability of larger habitats to support greater populations with lower extinction probabilities.

### **c) Restoration of degraded ecosystem**

Ecological restoration is the process of repairing damage caused by humans to the diversity and dynamics of indigenous ecosystems. Restoration ecology provides theories and techniques to restore degraded ecosystems. The main approaches to restore the degraded ecosystem are

- i. *No action/Neglect*– can be used as restoration is too expensive, if previous attempts of restoration are failed or experiences has shown that the ecosystem will recover on its own.

- ii. *Replacement*– replacing a degraded area with another new type. E.g. replacing a degraded forest area with productive pasture.
- iii. *Enhancement*– is used for any activity that improves the values of an ecosystem. Eg. Constructing water holes in desert reserve areas.
- iv. *Rehabilitation*– shifting the degraded habitat toward a greater value or higher than it is serving currently. It is simply improving degraded habitat, for instance, replacing a degraded forest with tree plantation.
- v. *Restoration*– is the conversion of the degraded habitat to its original species composition and structure by active program of site modification and reintroduction of the original species.



**Figure 6.** A conceptual representation of ecosystem degradation, restoration, and related processes

#### **d) Combating desertification**

United Nations Convention to Combat Desertification (UNCCD) defines desertification as: "land degradation in arid, semi-arid and sub-humid tropics caused by a combination of climatic factors and human activities." Desertification is a gradual process of loss of soil productivity and the thinning out of the vegetative cover, mainly due to human related activities, in addition to climatic variations such as drought and floods. Desertification is an economic, social and environmental problem in which international community has long been concerned. It contributes to different consequences such as mass migration, loss of biodiversity, climate change, global warming and the need for emergency assistance. It resulted in loss of productivity in farming and grazing land.

It is important to fight against desertification as it is one of the root causes of socio-economic problems, threatening the environmental equilibrium in the affected regions. When the top soil is mistreated, blown and washed away, it takes centuries to build up. To minimize the consequences of desertification, we have to focus on improving land productivity, rehabilitation of land, conservation and sustainable management of land and water resources. There are some major forms of mitigation of the impacts from roads, airports, etc to restore the ecosystem.

- a. The impact should be avoided altogether. E.g. By relocating the development site to the already degraded site.
- b. If the impact cannot be avoided, the site should be restored or at least rehabilitated.
- c. If the impacts are permanent, another nearby degraded site should be restored.

#### **4.8. Managing conservation areas**

Protected areas such as national parks and other represent an approach to resource use that provides a multiple flow of benefits to society. Human influence on the planet is already too great to imagine that any protected area is still totally "natural or stable". Protecting anything of nature, whether it is a single species or a whole representative ecosystem, requires management intervention to ensure that the desirable environment is maintained.

##### **Basic Information required in managing a given conservation area**

To manage protected or conservation areas with any degree of efficiency and safety, the manager must first know and understand the way in which the various ecosystems involved operate, and the effect of man upon them.

I. Biophysical features on which the manager will require accurate, scientifically collected information before he /she can prepare a comprehensive plan for the long-term management of a protected or conservation area.

- a. *Inventory*- It involves understanding of the following and other related set of questions or issues: What plants, animals, and other natural resources are present? Are there reliable estimates of species and population densities? How are they distributed in space and time? What are the important medicinal plants and other wild relatives of domestic species? What are the water-runoff rates and amounts of measurable pollution? Are there geological and soil map? What are the threats to the park?
- b. *Species needs*- As much information as possible should be gathered on status, particular habitat requirements, shelter, food, minerals and water needs of specie of special management significance.
- c. *Ecological relationships*- Involves understanding of the following and other related questions or set of issues: what animal eats what? What plant competes with what? What otherwise depend on what? What are the key species maintaining the integrity and functioning of the ecosystem?
- d. *Monitoring and dynamics of change*- Studies are needed on colonization and restoration of disturbed areas, invasion by new species, changes of river flow or quality, population trends within species. Is there evidence of climatic change?
- e. *Predictive manipulation of ecosystem*- Where the natural processes of change are contrary to the objectives of management, the manager will want to prevent change or affect its direction. To do this will require special knowledge of the direct and indirect, short-terms and long-terms, effects of different management interventions on ecosystem processes.

II. Apart from the biophysical topics, a manager will need information on the effects of his or her conservation area on local economy and society. He or she must also be aware of the effects on the reserve, of visitors use and others human activities. Areas on which managers require Socio-economic information include.

- a. *Resident and neighboring population*- Require understanding of the following and other related questions: how do local people and use the reserve / conservation area? What benefits do they receive, and what are the direct costs to them? How best can their

cooperation be fostered? What traditional knowledge of the use of the reserve's resources has been documented? What is the history of human occupation?

- b. *Economic Valuation*- What are the estimates of reserves economic values in terms of protecting watersheds and fisheries, ensuring biodiversity conservation, tourism expenditures, and its role in regional economic development and local employment, which values can be quantified.
- c. *Recreation and tourism*- What is the market area of the reserve? How many visitors use the reserve? Where and when? What other attractions and opportunities are found in the region? What impacts (environmental and economic) do they have? Are facilities and services adequate?
- d. *Management and administration*- How effective is the legal basis for the reserve? What staff- training methods are most effective? What are the administrative and policy frame works available? What are the best mechanisms to ensure staff recruitment and cooperative arrangement with local authorities and private organization? What are the linkages between the reserve and surrounding lands? What is the best means to obtain public participation? How international programs and conventions could be used to foster and support research in the reserve

The following management measures can be considered to help a declining or dangerously small population of a species of special interest:

- ☞ Stopping habitat alteration, which is a primary cause of wildlife extinction. In practice, this means enforcing conservation laws, renouncing logging concessions, and controlling tree felling, collection of other forest produce, forest fires and clearing and burning new farm land. In certain cases, the habitat may require restoration by artificial means, i.e. seeding, planting or other propagation methods of vital food plants, clearing and maintenance of grazing grounds.
- ☞ Extending or increasing protection to migration corridors, breeding sites or roosts or nesting sites (e.g. provision of nest boxes).
- ☞ Developing habitat management. This includes all forms of manipulation of the vegetation to make it more suitable for the species in question. For grazers and browser, this might mean preventing woodlands from reaching climax or even maintaining cleared or burned areas of grassland to maintain feeding areas. It can include planting or removing particular plants. In Sarawak, Malaysia for example, a method called

“liberation thinning” was proposed whereby large timber trees in reserves were to be ring-barked to kill them so that the smaller fruit trees which provide the bulk of the food for the arboreal animals would be ‘liberated’, enabling them to grow faster and be more productive (Proun and Hutchinson, 1980).

- ☞ Actively protecting the endangered species. This involves improving patrols, controlling illegal hunting and trapping, and adopting special intensive anti-poaching measures, e.g. actually guarding animals by day and enclosing them at night as had to be done with the introduced white rhinos in Kenya’s Meru National park.
- ☞ Reducing predation of the young by physically excluding potential predators, e.g. by fencing turtle nests to prevent egg predation by monitor lizards and wild pigs.
- ☞ Head starting. This can include artificial hatching of eggs and rearing of young to reduce early mortalities, but there may be difficulties in releasing the young again as many species need to imprint on either their parents or their birthplace. This method has been successfully applied to megapode nesting areas for crocodiles in Zimbabwe and Ethiopia.
- ☞ Provisioning’- providing extra food, water, minerals at salt licks and shelters or by planting favorite food plants is often quite effective and is usually only necessary for a short period or critical part of the year. Problems may arise if this results in causing unnatural concentrations of animals, which render them vulnerable to predation or disease. It may also cause local damage to the vegetation, as has occurred at many park waterholes in Africa.
- ☞ Controlling or elimination exotic or non-indigenous animals which may severely disturb and compete with the indigenous community. Such introduced animals are a major cause of Island extinction. Reducing competitors is a rather drastic action but may be justifiable if the competitor in question is an exotic or feral species or present in unnaturally high numbers or to save a threatened ecotonal species. The control of the introduced kikuyu grass and other exotic species in Hawaii Volcanoes National Park is an example where such action is needed.
- ☞ Controlling or (better) eliminating feral animals (i.e. domestic animals that have run wild) as they may kill. Compete or interbreed with wildlife (e.g. the goats on the Galapagos Islands and cats on Kiribati and dogs in BMN Park in Ethiopia).
- ☞ Reducing the levels of predators. This is justifiable only if the predators are exotics. Indeed the local predators are often the most threatened species of the ecosystem. Usually predators are actually helping to maintain optimal density and good health in a

prey species by removing sick animals from the population. Over killing of wolves in Alaska resulted in a drop, not an increase, in the numbers of their main prey, the Caribou.

- ☞ **Controlling disease.** High mortality, whether caused by disease, predation, hunting or poaching, (except for commercial reasons) has rarely led to extinction of a wild life species. Even an epizootic like rinderpest, which severely ravaged the populations of African buffalo at the turn of the century, did not cause the species to become endangered. However epizootics may become an acute threat to a species already rare or endangered particularly when the disease originates in a population of a species sharing the habitat with the rare species.
- ☞ **Relocation part of a population.** Where suitable habitats are available, part of the population of an endangered species should be moved there to avoid the risks of having only one, or a few, populations of a particular species. Where possible, this risk should be spread internationally to avoid extinctions due to political unrest.
- ☞ **Restocking,** this can be used to re-establish a population in areas where it has become extinct or is very rare by relocating individuals from wild stock elsewhere or releasing captive-bred animals. Before boosting populations by restocking the manager must first discover why the original population was dwindling. There is no point in raising the population level if the habitat cannot support greater numbers.
- ☞ **Breeding in captivity, or from seed and sperm banks.** This can be a last means to save a species from extinction. Captive-bred individuals can subsequently be re-introduced in protected, appropriate habitats. The success stories of the NeNe goose (Hawaii), Arabian oryx (Oman) and white rhinoceros of Natal are well known. Captive propagation should be carried out in a safe place, for instance in zoos of good reputation or institutions especially equipped for propagation endangered species. Captive breeding may also be done on site, in the species' own habitat, under rigorous protection. There may be some problems in capturing wild animals for breeding stock, e.g. shock, stress, and mortality during immobilization and transportation. The animals' physiology and behavior may also change in captivity and adversely affect breeding success.
- ☞ **Creating new legislation.** This may be necessary when existing laws are no longer appropriate to guarantee survival of the species.



## UNIT FIVE: CURRENT STATUS OF WILDLIFE IN ETHIOPIA

### 5.1. Wildlife resources of Ethiopia

The biogeography of the country is characterized by highland plateau. Although relatively young in evolutionary terms and has experienced relative climatic instability over the past 1.5 million years (both in contrast to the arid horn), highland isolation has resulted in significant endemism. Overall, the arid horn and young highlands are relatively impoverished in species number; the levels of endemism are high. Therefore, Ethiopia has over 6,000 species of vascular plant (with 625 endemic species and 669 near-endemic species, and one endemic plant genus), 862 avian species (16 endemic species and two endemic genera), 288 species of mammal (31 endemic species and six endemic genera), 201 species of reptile (9 endemic species), 64 species of amphibians (30 endemic species), 150 freshwater fish (40 endemic species). The vegetation of the country falls into five recognized biomes: Sudanian, Congo- Guinean, Sahel arid zone, Somali-Maasai, and the Afro-tropical and montane.

There are a number of charismatic flagship species, most notably the gelada (an endemic genus, *Theropithecus*, and the world's only grazing primate), the mountain Nyala, the Ethiopian wolf, the Walia ibex and the giant lobelia. The global significance of the area has been recognized through Conservation International's Biodiversity Hotspots. The country spans two Hotspots: the Horn of Africa and the Ethiopian Highlands (which is included in the Eastern Afro-montane Hotspot). The areas included in the Hotspots covers the majority of the country, including the entire eastern area of Ethiopia below 1,100m ASL and all highland areas above 1,100m ASL. There is a further critical aspect to the environment – the ecological processes.

There are seven major river basins (Webe Shebelle, Awash, Omo, Juba and Blue Nile) – comprised of the Takeze, Baro-Akobo and Abbai; in the highlands of Ethiopia that provide water for the people, livestock, wildlife and riparian vegetation in the lowlands. This is the highland lowland system where resources are not equally distributed but are dynamically interlinked. Thus, the people, livestock, wildlife and riparian vegetation in the lowlands are dependent on the good management and protection of the watersheds in the highlands.

### 5.2. Wildlife in national parks and natural reserves

Rather obviously, this analysis sets some of the conservation priorities for Ethiopia. The high altitude Afro-alpine moorlands, above 3500 m, are important for their plants, as well as for the

endemic mammals that occur there. The Ethiopian Wolf is the most critical of these. With a world population of around 500 animals, it is certainly the rarest canid in the world, and the rarest of the large endemics in Ethiopia. Agricultural pressures on the grasslands that support its rodent prey, as well as the risks of rabies spreading from domestic dogs, are major threats. The encouraging thing is the realization, internationally and within Ethiopia, of the importance of safeguarding the small surviving Ethiopian Wolf populations, and the efforts being made to encourage the local Human populations to respect and conserve them and their habitats.

Forest is a highly threatened habitat, in Africa generally and especially in Ethiopia. Wood is important fuel, still, which might in due course be supplanted by solar and hydroelectric power. More critical, its clearance reflects the need for further agricultural land in a still largely agricultural community. The contrasting pressure, less perceptible to the local community but critical nationally, is the essential safeguarding of forests for soil conservation on steep mountain slopes and especially, in safeguarding the water-gathering grounds (water catchments). In Bale, the forests are home not only to the Mountain Nyala but also to the Bale Monkey, and the increasing number of small mammals, still being recognized (e.g. *Cercopithecus harenni*, *Lophuromys chrysopus*, *L. brevicaudus*).

The principal agent for promoting conservation in Ethiopia is EWCA (Ethiopian Wildlife Conservation Authority), and the most obvious tool at its disposal is the establishment and conservation of protected areas (National Parks, Wildlife Sanctuaries, Wildlife Reserves, Wilderness areas and private or community conserved areas). Control of hunting and promotion of ecotourism are also valuable tools. The term wildlife (in Amharic Yedur Hiwot) has broad connotations. It includes all forms of wild-living organisms and their habitats. Recently, culture has also been included as a component, as the concept involves community as well. A protected area is a clearly defined geographical space. Recognized and managed through legal means to achieve the conservation of nature with its ecosystem services and cultural values. At present, protected areas include a wide range of management approaches, from those where human uses of resources are prohibited to multiple-use areas where limited sustainable exploitation of resources is allowed.

The history of conservation in Ethiopia dates back to the period of Emperor Zereayacob in the sixteenth century when the Wechacha area (Menagesha Forest) was replanted by collecting seeds

and seedlings of juniper trees from Wofwasha forest to protect it from being deforested. Formal wildlife conservation was initiated by Emperor Menelik proclaiming the regulations that consisted of nine chapters in 1909 (1901 E. C). A further regulation was proclaimed by Emperor Haileselassie in 1944 (1963 E.C) to conserve, develop and sustainably use resources. The follow up and execution of this mandate were given to the Ministry of Agriculture in 1946 (1938 E.C). As part of the forestry and hunting department, initially, the focus was on sport hunting and little attention was given to conservation and community participation.

However, Ethiopian wildlife conservation authority (EWCA) was officially inaugurated in 1965 (1957 E.C) with a portfolio that included responsibility for 9 national parks (including Dahlak in Eritrea), three wildlife reserves, 8 wildlife protected areas and 18 controlled hunting areas. It was initially established as an authority managed by an established board. However, during the military regime, it was amalgamated with the forestry division as the Forestry and Wildlife Department in the Ministry of Agriculture. Since then, it has continually changed status under different names, which has contributed to its inactivity or ineffectiveness through these years.

In 1996, it was thought that the protected areas belonged to the local communities and as a result the seven national parks and one wildlife reserve were transferred to the responsibility of regional governments. Through time, many of these protected areas showed little improvement and some even became impoverished as a result of scant attention provided by regional governments, except the Amhara and Southern Nations Regional States. This led to pressure to change these views, and recently a proclamation was introduced to help protect the dwindling wildlife. Responsibility for protecting wildlife was transferred to the Ministry of Culture and Tourism, within which EWCA has authority status.

In 2007, a proclamation (54/2007) for the development of conservation and utilization of wildlife became functional. This proclamation is supposed to control the unplanned and inappropriate utilization of wildlife, and to allow the participation of local communities and investors. The existing regulations did not consider the objectives of the existing reality and to maximize economic profit obtained from the wildlife resources, the need for this new proclamation was necessary. According to this proclamation, national parks that are nationally and globally significant, that harbor endemic and endangered species, areas that border within the regions and areas that are trans-boundary were to be administered by the Federal Government. Then in 2008,

the council of ministers approved regulation number 163/2008, printed in Negarit Gazeta, on wildlife development, conservation and utilization. This regulation clearly explains that the existing boundaries of conservation areas shall be maintained or re-delineated by the Federal Government in consultation with the Regional Governments to improve their management. It also itemized wildlife conservation areas (National Parks) administered by the Federal government as: Semien, Bale, Nechisar, Omo, Abijata-Shala Lakes, Awash, Senkele Swayne's Hartebeest Sanctuary, Babille Elephant Sanctuary, Gambella, Alatish, Kafta-Shiraro and Geralle. The regulation itemizes the list of 54 mammal species to be hunted under licence. At the same time, it enumerates 26 species of mammals that can be exported live with licence.

The list identifies 25 species of mammals as protected species whose hunting is not allowed. Unfortunately, Mountain Nyala is not included in this list while Black Rhinoceros, which is supposed to be extinct in the country, is listed optimistically among the protected species. At the same time dugong, which cannot occur in the current jurisdiction of Ethiopia, is included in the protected list, as are the female and young of any species. The authors stress that detailed ecological information and population size of a given species should be known before a licence is provided.

At present, Ethiopia possesses 49 protected areas under different IUCN categories, covering 73, 279 km<sup>2</sup> (6.5% of the total land mass). However, if forest priority areas are included, the percentage might reach about 12%. Recently, most governments throughout the world have agreed to increase the extent of land-based protected areas to 17% of the earth's surface. The government manages national parks, wildlife sanctuaries and wildlife reserves, whereas controlled hunting areas are managed by hunting companies under concession. Wildlife reserves act as a buffer zone and wildlife corridors are necessary for adjacent conservation areas with the objective of future transformation to national parks or sanctuaries. At present, there are 14 national parks, 3 wildlife sanctuaries, 7 wildlife reserves and 24 controlled hunting area managed by federal, regional and private parties. Protected areas managed by different institutions are given in Tables below.

a) National Parks	Area (Km <sup>2</sup> )	Established	Region
Abijata-Shala lakes	887	1970	Oromia
Alatish	2665	2005	Amhara
Awash	756	1966	Oromia & Afar
Bale Mountains	2200	1970	Oromia
Gambela	5061	1974	Gambela
Geralle	3858	2006	Somale
Kafta-Sheraro	5000	2007	Tigray
Nechisar	514	1974	Southern Nations
Omo	4068	1967	
Simen Mountains	412?	1966	Amhara
Yangudi-Rassa	4731	1977	Afar
b) Sanctuaries			
Senkelle hartebeest	54	1972	Oromia & Southern Nations
Babile Elephant	6982	1970	Oromia & Somale

Table 1. Protected areas managed by EWCA and their location.

a) National Parks	Area (Km <sup>2</sup> )	Established	Region
Chebera-Churchura	866	2005	Southern Nations
Mago	2157	1982	Southern Nations
Borena Saint	381	2008	Amhara
Maze	202	2005	Southern Nations
b) Sanctuary			
Yabellw Wildlife	2273	1986	Oromia
c) Wildlife reserves			
Aledeghi	1934		Afar
Awash West	42		Afar
Bale	1279		Oromia
Chelbi	4983		Oromia & southern Nations
Gewane	3283		Afar
Mille-Serdo wild ass	6504		Afar
Tama			Afar

Table 2. Protected areas managed by Regional Authorities.

Controlled Hunting Area	Area (km <sup>2</sup> )	Region
Avasheba-Demero	61	Oromia
Agarfa-Adaba	170	Oromia
Adaba-Dodola	33	Oromia
Arbagugu	35	Oromia
Berbere (Goba)	151	Oromia
Besmena-Oddu Bulu	46	Oromia
Blen-Hertele	154	Oromia
Chifra	203	Afar
Dati	555	Oromia
Dindin	788	Oromia
Eastern Harerghe	4161	Oromia
Hanto	26	Oromia
Haro Aba diko	72	Oromia
Hurufa Soma	215	Oromia
Jikao	353	Gambella
Munessa-Kuke	76	Oromia
Shedem-Berbere	26	Oromia
Sororo-Torgam	77	Oromia
Tedo	1443	Gambella
Telak-Dewe	728	Afar
Welshet-sala	139	Southern Nations
Werganbula	138	Oromia
Western Awash	967	Afar
Murle	639	Southern Nations

Table 3. Controlled Hunting Areas managed by Regional offices.

The major ecosystems represented by these protected areas include arid and semiarid areas, grassland, savannah, woodlands, forests, lakes, wetlands and mountains. Currently, EWCA manages 11 national parks, 2 wildlife sanctuaries in addition to regulating and administering quota setting and providing licenses for controlled hunting areas. EWCA has also responsibility

to help protected areas that have been already established and managed by regional centres or would be established protected areas.

**The Semien Mountains National Park:** - it covered 179 km<sup>2</sup>, and ranges from 1900-4543 m. It is long established, proposed in 1963 and gazette in 1969, and covers 755 of the range of the Walia, as well as spectacular scenery. Moreover, it is currently being extended to over 400 km<sup>2</sup>. The breath-taking landscape has led to its recognition as a World Heritage Site by UNESCO in 1978. Trekking is the most important tourist attraction, in addition to viewing the endemics. It suffers from agricultural encroachment, with tef and barley cultivation extending above 3200m, and grazing animals have further degraded the long grasslands that should provide habitat for small mammals. Small numbers of Ethiopian Wolf and large numbers of Gelada also occur. It has also benefited from extensive involvement of foreign advisors, park managers and research teams, especially the Swill. It was well established in the 1970s-80s, with a staff of 24, 45 buildings and a regular stream of tourists.

Rebellion and banditry caused its abandonment in 1983, and fighting during the military revolution of 1990-1991 caused complete destruction of all infrastructures. This has been reinstated, and tourism, based on Gondar and the nearby headquarters at Debark, is again a feature. The rainy season extends from June to September with annual rainfall of about 1500 mm. it experiences a cool climate ranging from -2.5 to 18<sup>0</sup>c. As a result of follow up and proper conservation action, the Walia population is building up, approaching about 1000, with funds obtained from the regional government and international donations, the settlers are being compensated and removed to a different location. A plan is underway by EWCA to translocate the settlers from Gich as well.





Figure 7. Walia Ibex found in the rugged semein mountains of North Ethiopia.

**The Awash National park:-** it was established in 1966, and gazette in 1969, on the site of a royal hunting preserve in the floor of the Rift Valley, not far (210 km) from Addis Ababa. It covers 756 km<sup>2</sup>, between the Awash and Cassam Rivers. It ranges from 750-2007 m in altitude. Mountain Fantalle, a dormant volcano, dominates the landscape; former lava flows and blister caves, important for bats and other mammals, are an important feature, as are the hot springs (filhoa). The headquarters are located at Gotu, near the Awash River. The average annual rainfall is about 570 mm, with temperatures ranging from 9.6 to 42<sup>0</sup>c. The small rain extends from February to April and the main rain from July to September. The area conserved a good variety of the main game, especially the Somali-arid species including Wild ass, Oryx, Grevy's Zebra, soemmering's Gazelle and Lesser Kudu. Black Rhinoceros, Elephant and Buffalo, which once occurred, were long exterminated when the park was founded.

An attempt to reinstate Swayne's Hartebeest has failed; 89 were brought from Senkelle in 1974, but only 10 survived in 1996, and none now. Wild Ass have been absent for 50 years, and Grevy's Zebra also seem to have disappeared since 1970. Incursions by pastoralists and their livestock caused ecological damage even in the 1970s, but tourism, helped by the proximity to Addis Ababa and good transport links (rail and road), was then well developed. Sadly, the turmoil of 1991 caused some damage, to both the park and its livestock but it is now recovering. The current manpower of the park stands at 67. However, additional manpower is needed for its proper protection.

**Conservation issues** (Birdlife International). The most important issue has been and continues to be intertribal conflict over the traditional rights of the Kerreyu, Afar, and Itu pastoralists for dry-season grazing and access to water, and the absence of adequate alternatives or compensation for these people. The infrastructure is largely intact, including about 180 kilometers of tracks, an airstrip, headquarters (including a small museum), staff buildings, a caravan hotel (in need of a major upgrade or revision to attract the modern tourist), and a campsite for visitors.

However, the park's management faces escalating human pressure from several permanent settlements in the park, and various tribal groups and their animals have moved into much of the park mostly on the western and northern sides. Fires are frequent. Pollution of the Awash River and Lake Beseka from a sugar estate and other large-scale irrigated farms upstream is a problem that must be monitored. The road and railway tracks that bisect the park are hazardous for the animals and provide easy access for poachers; these should be monitored. The park must be surveyed for unwanted vegetation (*Prosopis*), which must be treated when found.

**The Bale Mountain National park:-** is the most important for endemic small and large mammals. Proposed in 1971 and established in 1975, but still not gazette, it covers 2471 km<sup>2</sup>, and it is nearly as high as those of Semien, with peaks over 4,000 m, such as Tullu Demtu at 4,337 meters (14,225 feet), the second-highest peak in Ethiopia and Batu (4,307 meters). The head quarters are located at Dinshu at a distance 400 km from Addis Ababa. The reserve includes extensive Afro-alpine moorland on the Sanetti plateau which is the largest extent of Afro-alpine habitat in the African continent. Below a treeline at about 3300 m, the park extends, especially on the South side, through a Giant Heath zone into the Hareenna forest, with *Hagenia* and *Schefflera* at higher altitudes, *Aningeria* and *podocarpus* at lower levels, reaching a natural lower limit at 1500 m with Combretum woodland. On the North side are important dry forests with *Juniperus*. It is most important for the 1500 or so Mountain Nyala and over 400 Ethiopian wolves that it protects, but Bale Monkey, Giant Forest Hog, Giant Mole-rat and numerous endemic small mammals are also important.

The continuity of the forest zonation and the mix of forest and moorland species, as well as the active research and conservation activities, all reinforce its importance. Staff now number 65, but need to be doubled. Within an easy day's drive (557 km) of Addis Ababa, since the tarmac road was extended, the park is well founded with a lodge, herbarium, museum and research building.

In May, 1991 Nyala and Wolves were killed, and the staff had to be withdrawn; there was also some damage to infrastructure. However it has now been reinstated, and research has been resumed, November to February are the dry months followed by eight months of rainfall with temperatures ranging from -15 to 26<sup>0</sup>c.



Figure 8. Picture of Ethiopian wolf that is found in some highlands of Ethiopia.

The park is listed as a Biosphere Reserve by UNESCO's Man and the Biosphere Program; it is proposed as a World Heritage Site recognized by UNESCO (UNESCO World Heritage) and is currently on the tentative list pending final status. The park is the most important component of the Ethiopian Highlands Biodiversity Hotspot as recognized by Conservation International.

The Bale Mountains contain three distinct ecoregions: the northern plains, bush and woods; the central Sanetti Plateau, with an average elevation of more than 4,000 meters; and the southern Harenna Forest, known for its mammals, amphibians, and birds, including many endemic species. The central Sanetti Plateau is home to the largest population of the rare and critically endangered Ethiopian wolf. The Bale Mountains National Park has a number of Ethiopia's highland endemic species and many species not found elsewhere in sub-Saharan Africa. Above 3,000 meters elevation lie the Ethiopian montane moorlands, the largest Afroalpine region in Africa. The Afroalpine moorland in this park is extremely rich in endemic plants, with predictions of 30 percent highly plausible (Birdlife International11). The montane moorlands lie

above the tree line and consist of grassland and moorland with abundant herbs and some shrubs. The park warden reminded us that more than 265 species of birds have been recorded, including 6 Ethiopian endemics and many threatened species (Birdlife International); 80 mammals, with 17 endemics; and about 1,300 plants, with 163 endemics. This area also is the catchment for 40 springs and rivers that leave the park.

The Bale Mountains are a center of endemism. Endemic species include the Ethiopian wolf (the rarest *canid* in the world); the mountain Nyala; the Bale monkey; one bovid; one hare; and eight species of rodents, including the giant mole rat, which is found exclusively in the area. Several endemic amphibians are found only in Bale; 163 plants endemic to Ethiopia (23 to Bale alone) are present among 1,321 species of plants recorded there. The Harenna forest still contains habitats for lions, the endangered African wild dogs, and giant forest hogs. Seventeen percent of the Afroalpine habitat in Africa is found in the Bale Mountains. The Bale Mountains are critical to some 12 million downstream users living along the 40 springs and rivers that leave the mountains. Wild coffee and medicinal plant hotspots have been identified. Amazing scenic mountain and forest values, as well as cultural and social values, are associated with Bale Mountains National Park. Animals, including the Ethiopian wolf and mountain nyala, the wonderful scenery, trekking opportunities, and unique vegetation can be wonderful tourist attractions. Communities in other places have used wildlife to attract visitors.

**Conservation issues:** - The Park has not been legally gazetted. Livestock are still allowed to graze in all parts of the park, including the extreme high altitude Afroalpine area, and all habitats continue to be disturbed. In 2002, the livestock in a discrete area of the Bale Mountains reached an unprecedented density of 314 animals per square kilometer. Overgrazing also increases competition between livestock and wildlife species. The Ethiopian wolf is reportedly harassed on the Sanetti Plateau, where it is easily accessible from the road that passes through the park. The population also is affected by interbreeding, canine distemper, rabies caused by contact with local dogs, and negative attitudes and misconceptions about wolf predation on livestock.

Local people have always used the park, particularly the Sanetti Plateau and Harenna forest, but in the 1970s few people lived in the park and now thousands of people and their livestock are resident, particularly in the fertile river valleys in the north and on the Sanetti plateau. Burning of vegetation has increased, and the grazing pressure on the Afroalpine moorland is very high.

There is a conflict in the Harenna Forest between the needs of the lumber industry and the need to conserve the part of the forest within park boundaries. There is also increasing use of the forest to supply construction material, fuel, and charcoal for the expanding urban populations in the area. All levels of government, including the local council created to help develop plans for the park will be able to reduce the pressure from human usage on this unique and fragile area. The development of management plans for this and other protected areas shows that the stakeholders, scientists, and managers know what needs to be done to conserve the habitat and species; the greatest challenge is changing the culture and attitudes of all levels of involved people. Effective management of this critical area has been diminished by a lack of human and financial resources, political interest, and technical knowledge.

Two zones are planned for Bale Mountains National Park. The conservation zone comprises more 50 percent of the park, with relatively little permanent settlement. Settlement, infrastructure, and cultivation are allowed under negotiated management agreements for utilization of natural resources in both the conservation zone and the sustainable natural resource management zone. Threats include agriculture expansion; livestock overstocking; wood extraction; fire; settlement; unsustainable harvesting of non-timber products; poaching and human disturbance; disease; trampling of vegetation and track formation by livestock or vehicles; negative environmental impacts of infrastructure development such as quarrying, road kills, and litter; alien and invasive species such as dogs, cats, and plants; and small populations and insularity associated with a small and fragmented environment.

**The Mago National park:-** was proposed in 1971 and established on the ground in 1975, but is not gazette, covering 2162 km<sup>2</sup>, at 450-2528 m, on the East bank of the Omo, it was established to conserve the good numbers and variety of large game animals in this area. The other attractive feature of this area is the immense ethnic diversity, and cultural tourism is well developed as a result. At present, the park is managed by the Southern Nations and Nationalities Regional office. The fauna is similar to that in the Omo National park, but differs in having Grevy's Zebra (Fig) and Gerenuk, which are not known to cross the Omo River. Buffalo, Elephant, Plains Zebra and both kudus frequent the area. The park receives 900 mm of rainfall a year. The wet seasons are March to June and September, while the dry season extends from December to February; temperatures range from 20 to 40<sup>0</sup>c.



Figure 9. Picture of Grevy's Zebra in the Mago National park

**The Omo National park:** - It locates on the Weast bank of the Omo River, also protects a diversity of large game. Proposed in 1963, established in 1066, and not yet gazette, it covers 4068km<sup>2</sup> of savanna. Some 867 km south of Addis, it has an altitude range between 440-1183 m asl, interspersed with *Acacia-Commiphora* woodland and thickets of *Thornscrub* and *Riparian* woodland. The park receives 810 mm of rainfall annually. The wet seasons are from March to June and September. Temperatures range from 20 to 40<sup>0</sup>c. The large herds of Eland, as well as Elephant, plains Zebra, Giraffe, Hartebeest, Tiang, Grant's gazelle and Buffalo are important. Black Rhinoceros survived to about 1980, but is feared now extinct. The park used to be accessible by vehicle through the Mago-Omo bridge. Unfortunately, the bridge has collapsed and never been repaired. The park is accessible only by ferry boat from the Mago side. The alternative is to drive through Jima-Bonga-Mizanteferi and Maji. The park has a staff of 52, but needs more than double for effective conservation work; they struggle to maintain an active presence against the logistic problems, and the pressures of poachers from both locally and far away.

**The Nechisar National park:** - It located near Arbaminch and on God's Bridge between Lakes Chamo and Abaya was proposed in 1967 and established in 1972, though still not gazette. It covers 514 km<sup>2</sup>, including some 78 km<sup>2</sup> of lake surface, at 1108-1650 m<sup>2</sup>. Much is boulder-strewn grassland, but with *Acacic-Commiphora* woodland, dense *Acacia* in the gulleys, and riparian gallery forest along the lake shores and the rivers. The area receives 800 mm of rainfall



annually. The wet seasons extend from April to June and September to October. December to February are the hottest months of the year and temperature ranges from 17 to 36<sup>0</sup>c. It was established especially to protect the small population of Swayne's Hartebeest, though it is not thriving. The native 80-100 were supplemented by 110 more in 1974, moved from Senkelle, but had declined to 40 in 1990 and only 10 in 2010. There are good herds of plains Zebra, Grant's gazelle and Greater Kudu. Once, Oryx, Elephant, Black Rhinoceros and Buffalo also occurred here, but they had long gone before the park was established. So far, 53 individuals form the human resources, which need to be enlarged. There was an attempt to promote the area through the African parks franchise as a concession, but this has recently failed due to disagreement on management and the unsuccessful attempt to translocate the two ethnic groups to different sites.

**The Gambela National park:** - It was proposed in 1973, but has never been properly established. It should cover 5061 km<sup>2</sup> in the W lowlands at 400-768m, and should protect the migratory populations of Kob as well as the Nile Lechwe. At present, as a result of vast plots of agricultural land being allocated to entrepreneurs, there is a need to redefine the boundary without jeopardizing development activity. EWCA is pushing hard in collaboration with the regional authorities to finalize the boundaries because of its importance as a trans-boundary park. There is even a suggestion of working closely with Boma National park in Sudan as the Boma-Gambela heartland or biosphere reserve. The area receives 1400 mm of rain annually, with the rainy season extending from April to October. The main dry season is from November to March with temperatures exceeding 40<sup>0</sup>c. In the 1960s, there were large herds of Elephant, giraffe, Buffalo, Tiang, Hartebeest and Roan Antelope, but by the 1970s these had been reduced to small remnants by overhunting due to the civil war in southern Sudan. At present, the population of White-eared kob is increasing and about a million have been counted at the border in the Sudan. The area harbours the second largest migration of mammals in the world, next to Masai-Mara. Recently, the area has been strengthened by the allocation of more manpower (59) and conservation effort is being initiated. These staffs are mostly stationed in the nearby town of Gambela, on the far side of the R. Baro from the park, so logistical and other problems have hindered any attempt at serious conservation efforts here.

There are in addition four game sanctuaries set up to protect specific species. The Yagundi-Rassa National park was proposed in 1972 to protect one of the last populations of Wild Ass in 4731 km<sup>2</sup> of semi-desert grassland on the East bank of the Awash. The altitude ranges from 400-1460



m asl. February and March as well as July and August have rains and the temperature can exceed 42<sup>0</sup>c. Besides the Wild Ass, Soemmerring's Gazelle, Hamadryas Baboon, Gerenuk, Cheetah, Leopard, Lion, Greater and Lesser Kudus occur. At present, 19 staffs are allocated and the headquarters are located at Gewane town, 45 km from the border of the park. As a result, conservation activities nearby Mile-Serdo wildlife reserve.

**The Babille Elephant Sactuary:-** covering a limited area of the Dacatta, Fafan, Erer and Gobelle valleys, was intended to protect the small population of the Somali race of the Elephant, the only known survivors. The sanctuary was established in 1970 covering an area of 6982 km<sup>2</sup>. However, this has been reduced recently due to human and agricultural expansion. It is situated at the boundary of the Oromiya and Somale Regions, 560 km east of Addis Ababa at 08<sup>0</sup>25'-09<sup>0</sup>06'N, 42001'-43<sup>0</sup>06'E. The altitude ranges between 50-1785 m asl. Scrub woodland and bushland vegetation are the dominant ones. The area receives about 600 mm of rainfall annually. So far, 59 species of mammals are recorded including eastern expansion of few small mammals and two species of undescribed species (Lavrenchenko et al. 2011). It is a significant conservation area with different zoogeographical affinity.

**The Abijata-Shalla Lakes National parks:-** It was proposed especially to protect the aquatic birdlife, specifically the Great White Pelican *Pelecanus onocrotalus* and Lesser Flamingo *phoeniconaias* minor, though the northernmost Grant 's gazelle occur here. It has proved impossible to regulate human activities in this area, and the whole of the park's infrastructure was thoroughly destroyed in 1991, though rehabilitated immediately. Located at 207 km from Addis a;pmg a tar,ac rpad. Ot os a sogmofocamt prmotjp;pgoca; sote fpr tpirosts/ the a;totide ramges frp, 1540 tp 2075 m. It receves about 600 mm rain annually and the main rain is from june to September. The temperature ranges from 5 to 45<sup>0</sup>c.

**Conservation issues: -** The Park has not been legally gazetted. Adjacent to the major recreation resort of Lake Langano, the park received many visitors in the 1980s although it did not receive the support of the local people. During the early 1990s, the park went into decline. Local people use the area for agriculture and grazing despite the unsuitability of the soil. Additionally, much of the *Acacia* woodland surrounding Abijatta has been cut down for charcoal. People from the urban centers used to come and fish illegally in Lake Abijatta. The soda-ash extraction plant on the northeastern side of Lake Abijatta probably has the greatest impact on the area. Abijatta-

Shalla used to support one of the largest African colonies of *Pelecanus onocrotalus*; the birds bred on an island in Lake Shalla and fed their chicks on fish caught in Lake Abijatta. Pelicans and other fish-eating birds deserted the area because of declining fish stocks in the lake. This situation appears to be reversible: in December 1996, heavy rains caused the level of the lake to rise, and there were reports of fish in the lake and a group of pelicans apparently fishing. Key development requirements include an integrated water management and monitoring program, direction of revenue from the growing tourist industry to the wildlife authority, integration of local people in the development of the park, and control of access to and use of the woodlands.

**Alatish National Park:** - was established in 2006 and covers an area of 2665 km<sup>2</sup>. It is located 1025 km northwest of Addis in the Amhara Region. It is part of the Sudan-Guinea Biome. Elephant and Greater Kudu are the key species. Infrastructure development is in progress. It borders with Dinder N. pk. Of the Sudan and opens an opportunity for transboundary tourism development in the future.

**Kafto sheraro National park:**-it was established recently, covers an area of 5000 km<sup>2</sup> in the northwest part of Ethiopia bordering with Eritrea. The park harbours the northern remnant of African elephants in addition to Greater Kudu, Roan Antelope and Red-fronted Gazelle, elephants frequently migrate to Eritrea and as a trans boundary park, there is a need and opportunity to develop the park in cooperation with the Eritrean government.

**Geralle National park:**-it was established in 2006, covering an area of 3858 km<sup>2</sup> in the Somale Region. It is rumoured that Black Rhinoceros might survive here, but this is not yet confirmed. Unusually high numbers of Elephants and few Grevy's Zebras have been observed during last year's drought in Kenya. Although no study has been carried out, many of these animals might have migrated from Kenya to avoid the drought. In view of the wide home range required for elephants, the area nearby should be conserved to act as a corridor. The area is part of the Somali-Masai Biome. Faunal information from this newly established park is scant and there is a need for further study.

**Chebera-Churchura National park:** - was established in 2005 for its good population of elephants and Buffaloes. It covers an area of 1215 km<sup>2</sup> and is managed under the Southern Nations and Nationalities Region, which is located 460 km from Addis Ababa.

**Mazie National park:** - It Was established in 2005 and covers an area of 210 km<sup>2</sup>, also administered by Southern Nations and Nationalities Region. The area harbours good number of Oribi, swayne's Hartebeest and Buffalo.

Fully organized and implemented, this network of National parks and Reserves would offer reasonable chances of conserving all the large endemic mammals, and most of the small ones, for the future. Most serious, however, is the plight of the Somali-arid species, most of which have suffered severely from the years of misrule and anarchy in Somalia. Some extend to North Kenya, and might be safeguarded by the parks there, but others do not reach that far. Dibatag is the prime example, highly vulnerable, poorly known but very distinct. Salt's dikdik, Beira and Speke's Gazelle, as well, obviously, as wild Ass, Swayne's Hartebeest and Grevy's Zebra all need urgent attention.

In addition to protected areas run by Federal Government, regional governments have been working to add new protected areas as parks. The Amhara Regional Government is working hard to include Denkoro Chaka in Wolo and the one at tsisabay Falls as national parks. The Lake Tana region is also being considered as a sanctuary for birds. In addition, the Oromia Regional State, which covers 31% of the country and more than 50% of the country's fauna and flora, plans to Upgrade three areas as national parks: Dhati-Welel in the western part of the region that harbours thousands of Buffaloes and Hippos, which is part of the Sudan-guinean Biome assemblage; Yabello Wildlife sanctuary in the southern part which represents the Somali-Masai Biome assemblage and harbours both species of zebra in addition to its unique endemic birds; Arsi Highland park, including three mountain blocks-Chilalo, galama and Kaka-as well as the lowland area of Dera-Difekar along the Adama-Asela road, with a good population of kudus. The Arsi highland blocks have similar vegetation and fauna to Bale. Most of these highland areas are being seriously affected by human settlement, agriculture and cattle grazing. There is an urgent need to properly protect this area before it is too late.

Although there are a number of wildlife or nature clubs in schools and universities. They have not been aggressive enough to have a big impact in conservation action. The one conservation-based organization that makes a big impact in the community and advocates the wise use of natural resources is the Ethiopian Wildlife and natural History Society (EWNHS). This is an independent membership-based society which became a legally registered society in 1966. It is the oldest non-governmental environmental conservation organization in Ethiopia. It is also the

first national NGO in Ethiopia to sign agreements with EWCA to carry out studies in biodiversity conservation. It also has international links, e.g. in partnership with RSPB, and publishes its own journal *Walia*. The society has been legally registered under the new law as Charity number 0720. The main objectives of the society are conservation, development and sustainable utilization of the country's biodiversity through education, awareness raising, advocacy and research. Its major objectives include saving species, protecting sites, conserving habitats and empowering and improving the livelihood of Ethiopians (Clark, 2010).

### **5.2.1. Ecotourism**

Ecotourism has become one of the most influential concepts in the world of conservation. It emerged from terms like wildlife tourism and nature tourism, to become a universal conservation catch-word for sustainable development. Ecotourism in developing countries like Ethiopia, rich in natural and cultural heritage, is often considered to offer a sustainable source of revenue, given indigenous and rural communities the chance to benefit from and contribute to the global economy. At present, protected areas are facing a number of challenges due to the population explosion (especially settlement, agricultural expansion and cattle grazing). Properly planned and managed ecotourism can maximize the environmental impacts, significantly contributing to the well being of protected areas. Ethiopia has diverse wildlife species in addition to unique cultural and traditional resources which could sustain ecotourism. While ecotourism in Ethiopia is still in its infancy, it has significant potential for growth and development. The protected areas can offer leisure activities such as wildlife viewing, trekking, mountaineering and bird watching.

Formerly, awash provided an attractive venue for tourists and residents of Addis Ababa, and its proximity ensures that it could do so again. It should be relatively easy to restore the large herds of antelopes here if domestic livestock were removed; it might be necessary to extend its protective influence northwards into the Afar triangle to enable Gravy's Zebra and perhaps even wild Ass to recover here. Bale is also relatively accessible, and the relative ease of seeing such spectacular endemics as Ethiopian Wolf, Mountain Nyala and even the Giant Mole-rat, as well as many of the endemic Ethiopian birds, as already well appreciated by tourist guides to Ethiopia. Simian too has become again a specialist tourist venue. In addition to *Walia* and *Gelada*, the scenery is a major attraction. Even the locals are benefiting, by hiring their mules/horses to tourists on a shift basis.

There are already specialist bird watching tours arranged in countries like the UK and Germany to allow and encourage keen ornithologists (twitchers) to see as many as possible of the 30 or so endemic species in a three-week tour. The formerly almost unknown Ruspoli's turaco *Tauroco ruspoli* is now not only regularly seen on such tours, but local guides appreciate its value, and will show visitors to the best sites-for a small and welcome fee. Bird trips arranged to see all the endemics typically range as far N as the Great Abay gorge, to see Harwood's Francolin *francolinus harwoodi*, then head to the Rift Valley Lakes, before travelling via Bale and the Sanetti Plateau to the dry country beyond Negheli for the specialist larks and sparrows of the Ogaden. Returning from Negelli to Javello to see Ruspoli's Turaco, Stresemann's Bush-crow *Zavattariornis stresemanni* and White-tailed Swallow *Hirundo megaenisis*, the tour then returns to Addis Ababa up the Rift Valley. A similar mammal circuit could easily extend to simian to see Walia and Gelada, and go via awash for Soemmerring's Gazelle to Bale, to see Mountain Nyala, Ethiopian Wolf and Giant Mole-rat. It would offer a good chance of seeing most of the high altitude endemic birds and flowers at the same time.

New policies and legislation have been introduced that support the conservation of biodiversity and the sustainable use of these natural resources. The government of Ethiopia has recognized the value of developing and promoting ecotourism and provided consultancy services for a number of ecotourism sites. A few investors have begun involving themselves in the development of ecotourism in different areas of Ethiopia. Tourist numbers in Ethiopia have grown by 50% during 2003-2008. The potential to develop the tourist industry further is high. Such tourism would offer EWCA income from park fees and guides as well as support hotels, tour companies and airline. They would especially benefit remote rural communities, and offer an additional diversification of tourism, along with the historical sites of Axum, Gondar, Bahir Dar, Lalibela, the Monastery of Debre Damo, Sofomer cave, Temple of Yeha, the city walls of Harar and the archaeological and palaeontological sites in the lower valleys of the Awash and Omo.

Encouraging ecological tourism among the urban populace of Addis Ababa would encourage also a pride in the national fauna and flora which is going to be increasingly important. Visual arts, music, museums and exhibitions could also be part of ecotourism development. If properly managed and developed, we see a bright future in ecological, cultural, historical and religious tourism in Ethiopia.

### **5.2.2. Major threats to wildlife and tropical forests and actions for conservation**

It results from a very complex set of factors. At the top list is destruction of wild life homes and habitats. Threats to Ethiopia's biodiversity, tropical forests, and resource base can be broadly linked to the following categories: limited governmental, institutional, and legal capacity; population growth; land degradation; weak management of protected areas and deforestation. These threats are largely interrelated and self-reinforcing, whether they are direct (such as charcoal-driven deforestation) or indirect (such as limited governmental capacity as seen in the lack of enforcement of natural resource related policies). It is therefore important not only to understand the individual threats but also to examine them in a holistic fashion that recognizes their interrelation and to address these threats with a multi-sectoral approach. This section describes threats to biodiversity and tropical forests and recommends mitigating actions. These actions could be implemented by a number of sectors, including the government of Ethiopia, NGOs, international donors, research institutions or community-based organizations. The main threats of Ethiopian wildlife are describe as follows.

#### **A. Limited Governmental, Institutional and Legal Capacity**

The extent of degradation of Ethiopia's resource base and the open disregard for many natural resource-based policies demonstrates that the government of Ethiopia has been unable to ensure the protection and sustainable use of its biodiversity and forest assets. In general, there is quite a good framework for natural resource management in Ethiopia, and a number of established institutions monitor the environment. However, there is limited on-the-ground implementation of policy as well as marked limitations in stakeholder participation. This gap between policy and implementation can be attributed to unclear, incomplete, and contradictory policies. Contradictions may arise from disagreements among different sectoral authorities managing the same resource or area, or they may occur when there are discrepancies between federal and regional policies.

This disregard for federal policies may, in part, explain the lack of enforcement throughout the country and which is most noticeable with regard to illegal encroachment within the protected area system. In the national parks, the presence of cattle, sheep, goats, camels, and donkeys accompanied by herders and dogs inside park boundaries apparently without the herder's being concerned about the legality of their movements. This is not surprising given that these parks have not yet been officially gazette which in itself represents a lack of capacity to manage the

park system. In addition, we heard that, in many cases, conflicting agendas and political sensitivities led to the release of accused offenders and retribution against the game guards or wardens who had made the arrests. With disincentives for enforcement, a lack of official park boundaries, and no commitment by the government to control encroachment, people have no reason to curb their use of what has become an open access resource, to the detriment of the land base and wildlife.

**Actions for conservation:** - To address these threats, it is critical to raise the awareness of government decision makers responsible for forming and enforcing policies related to the importance of wildlife and sustainable management of natural resources. Awareness is also important regarding the negative impacts of policies as a result of contradictions, lack of enforcement, lack of time for testing and verification of ideas, and the introduction of inappropriate technologies. With 85 percent of the population depending directly on the use of natural resources (primarily for agriculture and grazing), it is necessary to clarify the importance of carefully crafting policies and then ensuring their enforcement. To this end, civil society organizations that are dedicated to examining natural resource issues should be strengthened so they can have more direct and forceful voices within the government. It is also important to facilitate dialogue among the government, civil society organizations, and national and international organizations by creating discussion opportunities through meetings, workshops, and inter-sectoral working groups.

There is also a need to closely examine policies, particularly those needing clarification or harmonization. Such examination requires awareness of the gaps that exist and acknowledgement of the need to revisit the policies. Next, the policies must be examined and specific issues identified through workshops, trainings, or studies so that all the necessary information can be gathered and all of interested parties can be heard. Once the time has been taken to hear all voices and consider all information, gaps may be filled and the policy framework can be improved. Additionally, implementation texts for on the ground managers should be created to ensure that those charged with enforcing and managing policies at the local level understand their roles and the intentions of policy makers. These texts should make legislation which is often necessarily complex easily understood by managers and local populations to whom the policies will need to be explained.



## **B. Population Growth**

Among the threats posed to wildlife, forests, and natural resources in Ethiopia is population growth. Population growth is the one that most directly drives and exacerbates the effects of the others. Population growth in Ethiopia is estimated at more than 2.2 percent per year, continually adding pressure to an already degraded resource base. With less land available per person, people are forced to farm or graze in more marginal areas of national parks and sanctuary, and areas that traditionally would have been left to recover must remain continually productive. Combined with a shortage of alternative livelihoods, population growth translates into greater pressure on the land and resources to provide for immediate human needs, thereby threatening the ultimate sustainability of the resource and the very existence of flora and fauna that depend on the same land increasingly used by humans.

**Actions for conservation:** - Population growth poses many challenges for Ethiopia and many organizations are working to help reduce its magnitude and mitigate its impacts. These efforts revolve primarily around family planning, which can most directly reduce pressure by decreasing or slowing the increase of the number of people depending on the resource base. Family planning efforts can involve education on the consequences of large families and family planning options as well as access to medical counseling and birth control.

In addition to education and family planning, actions that promote alternate livelihood activities can help to mitigate and reduce pressure from a growing population. The vast majority of Ethiopians currently earn their livelihoods from agricultural and/or pastoral activities, so programs that can offer alternate livelihood strategies (tourism, services, technology, commerce, etc.) can provide options that may not increase pressure on the degrading resource base. Along these lines, consideration should be given to developing hatcheries for fish production. Clean water from thermal springs, for example, could support the production a variety of fish and other aquatic organisms, such as frogs or crocodiles, for food or to supplement the native fisheries industry.

## **C. Land Degradation**

Land degradation in Ethiopia takes many forms, and it is encouraged by population growth and limited governmental capacity, as discussed above. In some areas that the assessment team visited in the Afar and Oromiya regions, land was so degraded that its capacity to continue to provide grass for livestock or soil nutrients for farming seemed minimal. Nevertheless, evidence

within enclosures and from discussions with local land managers showed that the land seemed resilient if allowed to rest. The primary source of land degradation in the pastoralist regions visited was overgrazing of livestock. This in turn leads to soil erosion in places where the stabilizing capacity of grasses is compromised, leading to siltation of water sources threatening their productivity for human and aquatic wildlife. Degraded land also allows invasive species to colonize or increase their presence in an area. Invasive species such as *Prosopis juliflora* in the Awash region and *Acacia drepanolobium* in the Borana and Oromiya regions has spread because fire suppression has decreased the land's value for grazing. With fire suppression, woody species such as *Prosopis* and *Acacia* gain ground over grasses, which increase their growth after fire clears away the woody species.

Additionally, both species are particularly resilient once established and must be dug out by the root so that they do not return which requires enormous labor. Land "lost" to these species is difficult to regain, and eradication efforts may need to concede to an effort to merely control their spread. There is also a marked lack of nutrient cycling in the farm and grazing lands, which further degrades the resource and hampers its ability to recover productive capacity. As fodder and fuel become scarcer with land overused and the population increasing, crop residues (which would be left to enrich the soils in many cropping systems) are removed from farms to feed livestock. Additionally, in some areas where wood sources are not readily available, manure is gathered and dried for fuel, thereby removing a critical element that can return nutrients to the soil for the next crop cycle. Without replacing the natural nutrients of crop residues and manure and with chemical additions too expensive and out of reach for many, farming may become more of an extractive than a sustainable endeavor, leaving lands no longer fit for crop production.

**Actions for conservation:** - Most actions to ameliorate land degradation, particularly in the pastoralist areas, involve reducing the immediate pressure of grazing to allow for recovery and growth of the grasses. Increasing the tenure and use rights of common grazing areas may encourage rational management of the resource by guaranteeing future benefits to those who forgo short-term gains. Efforts should be made also to eradicate invasive species, if possible, and to control them in areas sensitive to biodiversity and where people depend on grazing for their livelihoods. Current methods for control, which include cutting, burning, digging up roots, and plucking seedlings, can be effective, although they come at a high cost in labor. Chemical or mechanical methods should be considered if they can prove more effective in removing or

controlling invasive. Support should also be given to surveying the invasive species to map outlying locations (especially near protected areas) and treat them immediately to control expansion.

#### **D. Weak Management of Protected Areas**

Protected areas in Ethiopia represent about 16 percent of the country and are critical habitats for the country's most endangered wildlife. Although officially protected, these areas are generally marked by weak management capacity and continually degraded landscapes. The importance of zones to biodiversity and forest conservation in Ethiopia, they bear repeating with emphasis on the issues specific to protected areas. The issues of encroachment are quite severe and may, in some national parks, call into question the status of protected area. In the Abijatta-Shalla Lakes National Park, for example, the increase in villages, farms, and cattle has necessitated transfer of non-avian wildlife in the park to a closed corral for their protection.

In another case, herders and cattle were seen on the Sanetti Plateau in the Bale Mountains at more than 4,000 meters (13,125 feet) above sea level, where the nutritional value of the graze is minimal and vegetation in the high moist environment is prone to compaction and slow to grow and recover. This area is also a prime habitat for the highly endangered Ethiopian wolf; herders often bring dogs with them that may attack the wolves, spread rabies, and even interbreed with wolf populations. Without strong management, many parks have become *de facto* multiple-use, open access areas that are being degraded at an alarming rate. Although human use and even settlements are not inherently incompatible with protected areas, management and planning are necessary to mitigate their impacts and ensure that the resource base is used sustainably for both people and wildlife. Part of the reason for weak management of protected areas is the lack of financial resources. In some cases, as in the Bale Mountains, park staff has created ambitious management plans for protection, to work with communities within and around the park, and to develop tourism. But these plans are underfunded, and large portions will remain unimplemented until financial resources are available. In many cases, requests for the authority and financing to properly manage parks are unfulfilled; leading educated and motivated staff to become discouraged and parks to go essentially unmanaged. Exacerbating the lack of financial investment in protected areas is the lack of clear authority for their management.

Although officially under a federal mandate, authority for the management for national parks has been ceded to regional authorities. Without national-level coordination and backing, the management of parks is uneven across the country. Areas and species of world importance are left to regional authorities that may be understaffed and unqualified to manage these critical resources. At the time of this writing, however, the federal unit in charge of wildlife had just been promoted to the level of a semiautonomous authority within the Ministry of Culture and Tourism in order to gain a greater measure of federal control over the park system. It is hoped that this move will improve the current situation, in which critical decisions over national park management are made without even consulting federal authorities.

**Actions for conservation:** - Effective protection of protected areas should be a priority for expenditure of donor conservation funds, and the first action should be to have these areas 14 national parks, 3 wildlife sanctuaries, 7 wildlife reserves and 24 controlled hunting area officially gazette. This action can form the basis of negotiations and outreach to the local communities. In itself, however, gazetting will not be enough, and the government must make a real commitment to enforcing the rules and boundaries of the parks, developing policies that are reasonable for both communities and conservation, and ensuring that these policies are implemented on the ground.

To go along with increased enforcement of rules and boundaries, efforts to strengthen the relationships among parks and communities will be necessary. To this end, training of park staff and outreach to communities should be undertaken. These efforts should go hand in hand, particularly regarding the development of community tourism. Park staff will need to understand the importance of ensuring that communities realize benefits from tourism, and communities will need to receive significant benefits from tourism that are directly related to conservation activities. Park staff can be trained via workshops and seminars that take place in-country, as well as regional or international forums that allow managers of different protected areas to discuss common problems and share approaches and solutions.

Furthermore, key development requirements for any protected area include an integrated water, grazing, and forest management and monitoring program; direction of revenue from the tourist industry to the wildlife/tourism authority and park management; involvement of local people in the development of parks; and controlled use of and access to forests and woodlands.

Additionally, as wildlife knows no boundaries and “bigger is better” in terms of an area’s ability to sustain viable populations, efforts should be made to investigate and support, where feasible, trans-boundary conservation/peace parks with Sudan, Kenya, and Eritrea. With the responsibility for conservation of protected areas residing with the regional government, a coordinating link must exist between the federal and regional governments to ensure a consistent approach to management and conservation practices. More attention should be given to developing this area through collaboration among and participation by the regional and zonal bureaus and the local communities. Additionally, support for environmental education activities in communities around the protected areas also could help communities recognize the intrinsic value of protecting wildlife as well as the significant value of ecosystem services to the communities themselves and recommendations for the support of community-based ecotourism, particularly in the pastoralist areas of Southeastern Ethiopia.

### **E. Deforestation**

Of the total land area of Ethiopia, only 2.9 percent is covered with forests, with an estimated natural deforestation rate of 8 percent per year. The reasons for this deforestation are both direct such as the production of charcoal and timber and indirect such as lack of management capacity and population pressures, as discussed above. Particularly in the pastoralist areas visited by the assessment team, charcoal production seems to be one of the greatest drivers for deforestation. Although the tree cover for the area is rather sparse, charcoal could be seen sold in large quantities all along the route towards Djibouti (and elsewhere). Charcoal production is illegal, but its prevalence along the roadside showed that enforcement was lacking. Nevertheless, we saw a large confiscated shipment of charcoal, evidence that, at least in some cases, charcoal regulations were enforced. This is not to say that all charcoal production is necessarily bad, since it may be produced in a sustainable fashion or utilize an invasive species.

Protected forest species and areas also are threatened by unsustainable harvesting of trees and other forest products. In areas in the Oromiya region, for example, juniper forests which are, in theory, protected are exploited by local populations for fuel wood and construction. However, with no flexibility in the use of protected species and few alternatives to juniper wood, it would be unreasonable to expect the trees to be untouched. Nevertheless, with strong management and enforceable policies and sustainable use of alternate wood supplies, plans could be created to meet or reduce community needs. Other products such as the liana vine, wild spices, and

medicinal plants, also are being overexploited. Deforestation also occurs on land that is being cleared by increasing populations for agriculture.

Additionally, with use rights being codified only for agricultural lands, forests may be cleared so agricultural use rights can be officially bestowed. Fires also present a threat to forests, whether they are set intentionally to clear land for agriculture, to encourage new grass growth, and kill woody species that are unfavorable for grazing (it is illegal to set a fire, despite traditions of using fire to manage grazing lands), or are driven naturally by fire suppression and frequent droughts, which set favorable conditions of dry and abundant fuel. Even if a fire is natural, once forest land is cleared, agriculturalists normally plant the area, thereby ensuring that the forest will not return to its former state.

**Actions for conservation:-**To help slow or reverse deforestation in Ethiopia, it is important to raise the value of standing forests to people, show the benefits of sustainable timber harvest, or provides alternatives for forest products. Several plants used for medicinal purposes could be valuable in local, regional, and perhaps international markets. The use of appropriate, energy-efficient stoves, and other technologies that can reduce use of fuel, should be supported to reduce deforestation and health problems related to indoor pollution. These stoves also can replace the use of dung as fuel, which can allow this important resource to be used to increase soil fertility and improve agricultural productivity.

A particularly promising point of entry for improved technologies may be with commercial *injera* stoves. These stoves should be made locally, ensuring supply and synergistic economic development, and demonstrations should show the benefits (primarily savings in fuel expenses) to restaurants and wholesalers that produce large quantities of the staple. To encourage the sustainable harvest of forest products, it is important that people have secure tenure or use rights. As discussed previously, current policies do not allow for such rights over forest areas; therefore, rational people have no incentive to use the resources sustainably and every reason to get as much as they can for short-term use. To help decrease the demand on natural forests, individual plots for wood and timber should be encouraged, allowing people to plant and harvest wood products according to their needs.

Trees require a considerable investment in time and effort, however. Without secure use rights over the use of the mature product, people will not be willing to make the investment, limiting their tree plots to small areas near the homestead. Tree planting should be supported by local area nurseries, which have locally adapted native trees and shrubs. These efforts, however, should operate in tandem with environmental education to also demonstrate the ecosystem and social value of forests. Alternatively, commercial plantations could be expanded in areas with high production potential and low value for biodiversity. In many places, farmers use eucalyptus as a cash crop, and this practice should be expanded where possible. It is important to note that the selection of sites and species is critical for new plantations; popular tree species such as eucalyptus may not always adapt to local conditions and could pose threats such as overutilization of water resources, the release of allelopathic chemicals (threatening neighboring trees and crops), and the potential for invasiveness.

### **5.3. Wildlife outside of national parks and natural reserves**

The principles of conservation discussed above with reference to parks and reserves hold also for conservation outside those reserves. There are a few important differences. In general, protected areas cover no more than about 10% of the terrestrial global surface, which means from our species area that only about 50% of the world's species are included. Thus, at least half of our terrestrial biota must be conserved in human dominated systems. Some species or associations of species occur only rarely in reserves because parks and reserves do not capture a representative sample of the biota. In Australia, for example, few reserves contain forest types that grow on sites of high fertility. Most such sites were incorporated into state forests or alienated from common ownership before the reserve system was established. The koala (*Phascolarctos cinereus*) is dependent on such sites and so almost all attempts to conserve koalas must be made outside the reserve network where the manager does not have the same control over land use practices.

Legislation is the main means by which conservation is advanced outside reserves. Various practices, such as the killing of nominated species, are banned. Less commonly there are controls over land clearing, thereby protecting the habitat of species that dwell in forest and woodland. Activities on land owned by the people as a whole, even though that land is not designated as a conservation reserve, may be subject to environmental impact assessment (EIA). Laws



governing conservation outside reserves should take legal precedence over forestry and mining law.

Conservation outside parks is admired to benefit wildlife and people by expanding habitat and extending wildlife derived economic development, but living with wildlife can have costly, even deadly, drawbacks. Therefore, compensation schemes and wildlife-based benefit programs are intended to offset the financial cost of wildlife and to encourage people to protect wildlife. The need for ecosystem-wide monitoring has become more pressing as the goals of conservation have expanded from saving endangered species and national parks to sustaining biological diversity, ecosystem function and ecological services. Quantification of species trends and the factors governing population and ecosystem viability are vital to forecasting, planning and managing wildlife populations, and in auditing the success of alternative conservation policies and practices.

There are two main ways to conserve biodiversity. These are termed ex-situ (i.e. out of the natural habitat) and in-situ (within the natural habitat-national parks and nature reserves). Conservation outside the national park and nature reserve where organisms brought out of their natural habitat of the species for conservation of the elements of biodiversity is *Ex-situ* conservation. Ex-situ conservation means literally, "off-site conservation". It is the process of protecting an endangered species of plants or animals outside their natural habitats; for example, by removing part of the population from a threatened habitat and placing it in a new location, which may be a wild area or within the care of humans. The purposes of ex-situ conservation are recreation, education research and conservation. It aims to conserve the biodiversity but not include its habitat. It lacks environmental adaptation unlike in-situ conservation. It is not applied with all species. It has less local access while in situ has high local access.

Ex-situ conservation can be done by maintaining sample populations in zoos and botanic gardens which are considered by universal thinkers and environmentalists as important means of conserving biodiversity. Zoos became not only places of entertainment and observing animal behaviour, but as institutions, museums, *These forms may be reproduced* research laboratories and information banks of rare animals. Zoos and botanic gardens are small artificial forests in cities and places for animals, birds and reptiles in captivity, and centres for their reproduction.



Zoos and botanic gardens are banks to keep sperms of rare animals and reptiles threatened by extinction.

Zoos and botanical gardens are the most conventional methods of ex-situ conservation, all of which house whole, protected specimens for breeding and reintroduction into the wild when necessary and possible. These facilities provide not only housing and care for specimens of endangered species, but also have an educational value. They inform the public of the threatened status of endangered species and of those factors which cause the threat, with the hope of creating public interest in stopping and reversing those factors which jeopardize a species' survival in the first place. They are the most publicly visited ex-situ conservation sites.

- ☞ Zoos are established for animal diversity conservation (1100 zoos in the world), the role of zoos in the conservation of biodiversity became a legal obligation in many countries. They serve as supporters of wildlife conservation in the field. In the past, zoos were mainly display facilities for the purpose of public enjoyment and education. As large numbers of the species traditionally on display have become rarer in the wild, many zoos have taken on the additional role of building up numbers through captive breeding programmes. Individuals of a species, whose numbers are too low for survival in the wild, have been captured and the species has then been reintroduced to the wild after captive breeding. The role of zoos in conservation is limited both by space and by expenses.
- ☞ Botanical gardens are established for conservation of plants (>630 botanical gardens in the world). A botanical garden is a controlled and staffed institution for the maintenance of a living collection of plants under scientific management for purposes of education and research, together with such libraries, herbaria, laboratories, and museums as are essential to its particular undertakings. Each botanical garden naturally develops its own special fields of interests depending on its personnel, location, extent, available funds, and the terms of its charter. It may include greenhouses, test grounds, herbarium, an arboretum, and other departments. It maintains a scientific as well as a plant-growing staff.

### **Advantages of Ex-situ**

- To conserve species that has major threats of habitat degradation and loss.
- To collect genetically representative samples.
- Maintain samples off site in good condition for a long time, and be able to use them if needed.

- Use samples to reintroduce genetic material to the wild if necessary.
- To generate income through tourism and be used to conserve the species at in situ.
- Relative cost of ex situ conservation is low.

### **Disadvantages of Ex-situ**

- Ex-situ conservation is rarely enough to save a species from extinction. Because the number of populations represented under conservation is limited compared to the total genetic diversity of the group of organisms present in the region or elsewhere, i.e. limited by limitation of sampling. It is to be used as a last resort, or as a supplement to in-situ conservation because it cannot recreate the habitat as a whole. The entire genetic variation of a species, its symbiotic counterparts, might help a species adapt to its changing surroundings. Instead, ex-situ conservation removes the species from its natural ecological contexts, preserving it under semi-isolated conditions whereby natural evolution and adaptation processes are either temporarily halted or altered by introducing the specimen to an unnatural habitat. In the case of cryogenic (low temperature) storage methods, the preserved specimen's adaptation processes are frozen altogether. The downside to this is that, when re-released, the species may lack the genetic adaptations and mutations which would allow it to thrive in its ever-changing natural habitat. That is, it arrests evolutionary processes as the interaction with the environmental factors stopped.
- Furthermore, ex-situ conservation techniques are often costly, with cryogenic storage being economically infeasible in most cases since species stored in this manner cannot provide a profit but instead slowly drain the financial resources of the government or organization determined to operate them.
- Seedbanks are ineffective for certain plant genera with recalcitrant seeds that do not remain fertile for long periods of time.
- Diseases and pests foreign to the species, to which the species has no natural defense, may also cripple crops of protected plants in ex-situ plantations and in animals living in ex-situ breeding grounds.
- These factors, combined with the specific environmental needs of many species, some of which are nearly impossible to recreate by man, make ex-situ conservation impossible for a great number of the world's endangered flora and fauna.

The entire ex situ conservation methods discussed have their role to play in modern conservation. Generally, they are more expensive to maintain and should be regarded as complementary to in situ conservation methods. For example they may be the only option where *in situ* conservation is no longer possible.

### **5.3.1. Community-based conservation outside protected areas**

Rural communities may subsist for centuries in relative harmony with the environment and the wildlife that surrounds them. But economic straits/hardships, rapid population growth, political and cultural changes, and outside demand for resources can disrupt the balance of this relationship. In the face of industrial resource extraction and global trade, local governments cannot always enforce an area's traditional laws. The result is that communities may lose access to their land, water, and wildlife resources. Wildlife Conservation Strategy works with local people to help them manage their natural resources and trains them to become more effective stewards of their environment. WCS's approach combines creative thinking with solid business strategies to bolster/boost economies and living standards while protecting ecosystems and wildlife populations.

Management for wildlife can provide several benefits to landowners. Abundant wildlife populations and natural areas provide recreational opportunities, such as bird watching, fishing and hunting. Management practices for improving wildlife habitat often provide ecological benefits such as reduced soil erosion, higher water quality, and increased soil moisture. Some wildlife habitat improvements (like windbreaks) can reduce costs of home energy, cattle feed and equipment fuel. Creating habitat for bats and certain birds that consume insects might reduce the need for costly insecticides. Some landowners can receive additional income by establishing private or public wildlife recreation preserves on their land. In addition, many habitats intended to protect wildlife can serve as outdoor classrooms for children, who can learn to identify plants and animals as well as learn how human and environmental needs can be balanced.

Each wildlife species has different habitat requirements (food, water, shelter and space). Hence, they need key areas that could supply all their requirements. These areas may include old orchards or house sites, bottomland and streamside areas, fencelines and hedgerows, snags and fallen logs, rocks and caves. Once key wildlife areas are protected, you can determine which food and cover components need to be provided or enhanced.

### 5.3.2. Key areas used by wildlife outside national parks and nature reserves

Several different types of valuable wildlife habitats are found outside national parks and nature reserves such as farmlands. For instance, in cultivated ecosystems (completely modified natural habitat) such as in farm land and aquaculture (pond) pests and weeds are found unwontedly which farmers want to remove. Even in some big cultivated areas there are fences of shrubs where many species of rodents and other invertebrates can reside. Moreover, in built ecosystem there are many species of rodents, birds (like sparrows, finch, and pigeons), certain lizards and insects (such as cockroaches) on factories, industries and other buildings. Some of key areas for wildlife outside protected areas are:

- ☞ *Odd areas*- Odd areas are sites not well adapted for cultivation, such as seeps, bogs, caves, roadsides and ditches. Allow these areas to grow to provide habitat to a variety of animals. Permanent trees, shrubs and grasses can protect areas of shallow water near or within crop fields. Generally, exclusion of livestock from some areas provides the best vegetation diversity and structure for wildlife habitat. Reducing mowing frequency (especially roadside ditches) to once every 3-5 years augment the habitat quality for wildlife. These are excellent locations to plant native wildflowers and races. Old building structures such as barns are another good place to attract wildlife, such as barn owls.
- ☞ *Abandoned fields and edges*-Field borders containing trees, shrubs or grasses provide food for birds, small mammals, fox and deer, and provide nesting cover for many animals. Field borders adjacent to woodlots may be particularly productive for wildlife. Retaining a more natural or gradual field border will encourage use by different animals.
- ☞ *Orchards*- Orchards of fruit trees with grassy herbaceous understory (low vegetation) attract wildlife by providing food, cover, and nesting areas. Birds, such as bobwhite quail, might nest in grassy understories, while songbirds and mourning doves nest in fruit trees. In addition, fruit allowed to fall to the ground is an excellent food source.
- ☞ *Riparian Buffer Strips*- Riparian buffers are strips of permanent vegetation along waterways designated to intercept pollutants, reduce erosion, improve water quality, and provide habitat for wildlife. Streamside forests, in particular, help to maintain aquatic habitat for fish by providing shade, food, and in-stream woody structure for fish species. The width of the buffer zone and the plant species used will depend on the type of wildlife desired. A minimum width of 100-150 feet on both sides of the stream is often recommended to provide significant ecological and wildlife value.

- ☞ *Farm Ponds*- Farm ponds can be managed to attract diverse wildlife. Encourage vegetation growth around the shoreline to stabilize the edge and provide food and cover for wildlife. Herons, egrets, ducks and kingfishers may be attracted to these ponds for food resources. Floating logs or rafts allow loafing and sunning areas for salamanders, turtles and ducks. It is important to keep livestock out of the pond or away from the banks to reduce soil erosion and sedimentation. If livestock must use the pond, restriction to a small portion of the shoreline is indispensable.
- ☞ *Snags*- Snags are standing dead trees left for wildlife to use for food, shelter, and nesting. Cavity-nesting birds often comprise 20-40% of the birds in the forest, but a variety of mammals, amphibians and reptiles regularly use cavities too. Snags and dead limbs also are an important source of perches for birds. Red-tailed hawks, and other raptors that forage or nest in the open country use high perches to survey the land for prey. Low perches, less than 10 feet high, can provide sites for singing and catching insects by songbirds.
- ☞ *Brush Pile*- Brush piles can provide dense cover for ground-nesting birds, rabbits and other small mammals. Piles close to other food and cover sources, preferably along forest edges, field corners or along streams and marshes are important. Isolated piles may receive little use or could be detrimental if long distances between piles and suitable habitat make animals vulnerable to predators.
- ☞ *Fencerow/Hedgerow*- Fencerows (uncultivated land around fence) and hedgerows (row of bush) are important to wildlife for traveling, nesting, roosting and for cover from weather and predators. To improve suitability for wildlife, fencerows should be at least 30 feet wide and contain a variety of native plant species. This type of habitat can be easily created by modifying mowing practices or by planting soft mast-producing shrubs. Reducing or eliminating mowing or tilling areas adjacent to fences also can create hedgerow habitat.

Several federal and state voluntary programs exist to aid farmers and landowners in improving and maintaining habitat to benefit wildlife outside protected areas. These community-based conservation programs provide a flexible design of conservation practices and financial incentives to address environmental issues.

- \***Wildlife Habitat Incentives Program (WHIP)**: This is a program for landowners who want to develop and improve fish and wildlife habitat on private land. WHIP helps landowners' plan and cost-share wildlife habitat improvements in association with active farming operations.

- \*The Pesticide Environmental Stewardship Program (PESP) is a program that forms partnerships with pesticide users to reduce the health and environmental risks associated with pesticide use and implement pollution prevention strategies.
- \*Conservation Reserve Program (CRP) is a program which reduces soil erosion, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. Farmers are encouraged to convert highly erodible cropland or other environmentally-sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filter strips or riparian buffers.
- \*The Wetlands Reserve Program (WRP) is a program offering landowners the opportunity to protect, restore and enhance wetlands on their property. The WRP goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program.

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